IN INDUSTRY • IN TRANSPORTATION • ON THE SEA • IN THE AIR

Only 1/1000" difference in clearance

in main bearings after 5 years operation with GULF PARVIS OIL

The Gulf Engineer consults with plant men to insure highest possible lubricating efficiency

THAT'S REAL PROTECTION! When a lubricant cushions Diesel engine bearings so effectively that only 1/1000" difference in clearance can be detected after five years' continuous operation, the quality of that lubricant is thoroughly proved.

Such service records for Gulf Parvis Oil are not uncommon. When this quality Diesel oil is used — as recommended by an experienced Gulf engineer — wear is minimized and maintenance costs are kept down.

It is more than likely that the lubrication of *your* equipment can be further improved. The friendly cooperation of the Gulf engineer is available to all Diesel engine operators from Maine to Texas.

5 Reasons

Why Gulf PARVIS OILS Reduce Diesel Operating Costs

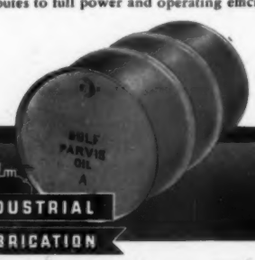
1 **GULF PARVIS OILS** are especially manufactured for lubrication of Diesel engines. High temperatures, contamination with fuel and moisture and constant churning in the presence of air—all encountered in Diesel engine operation—necessitate the use of an oil especially prepared to withstand these conditions.

2 **GULF PARVIS OILS** insure minimum wear of cylinders, pistons and bearings. The tough film provided by GULF PARVIS OILS is not readily removed from the cylinder walls and pistons, insuring proper lubrication of these parts at all times.

3 **GULF PARVIS OILS** insure minimum consumption. Because they are made from specially selected crudes and manufactured by the most modern refining methods, GULF PARVIS OILS withstand the high temperatures encountered in Diesel engine operation. A minimum of make-up oil is required.

4 **GULF PARVIS OILS** reduce operating costs. Because of the stability and high lubricating quality of these oils, wear and repair expense are minimized. Lower oil consumption and lower maintenance costs reflect substantial savings in over-all operating costs.

5 **GULF PARVIS OILS** are low in carbon content—a safeguard against carbon deposits resulting from the lubricating oil. With good atomization of fuel and complete combustion, rings retain their freedom. Thus, the oil contributes to full power and operating efficiency.



GULF OIL CORPORATION • GULF REFINING COMPANY

General Offices, Gulf Building, Pittsburgh, Pennsylvania

GULF INDUSTRIAL LUBRICATION

DIESEL PROGRESS for March, 1937. Volume III, No. 3. DIESEL PROGRESS is published monthly by Diesel Engines, Inc., 2 West Forty-fifth Street, New York, N. Y. Rex W. Wadman, President. Acceptance under the Act of June 5, 1934, at Brooklyn, New York, authorized May 14, 1935. Subscription rates: United States and Pan American countries $3.00, Canada and all other countries $5.00 per year. Single copy price 25 cents in U.S.A., 50 cents for all other countries.

a plain statement about diesel piston reliability

The high temperatures required in the Diesel cycle subject the materials making up the combustion chamber to severe heat problems.

Unless the heat generated is thoroughly distributed throughout the piston, high internal stresses result from great differences of temperature in different parts of the piston. Such stresses are the chief cause of piston failure.

Nature made Aluminum a superior conductor of heat. Consequently, heat distributes itself more uniformly through Aluminum alloy pistons, and minimizes these stresses.

This all-important, natural characteristic is the basic reason why you should specify Aluminum pistons. They are more reliable.

In high-speed Diesels, used in trucks and tractors, and also in railway applications, the light weight of Aluminum pistons also adds to reliability. They reduce reciprocating weight and, therefore, bearing pressures.

These are some of the reasons why nearly all Diesel builders have permitted us to work closely with them in piston development. We have been happy to contribute our experience with gasoline engine pistons, both for automobiles and aircraft, and to cooperate with the engine builders in solving the problems of each individual engine.

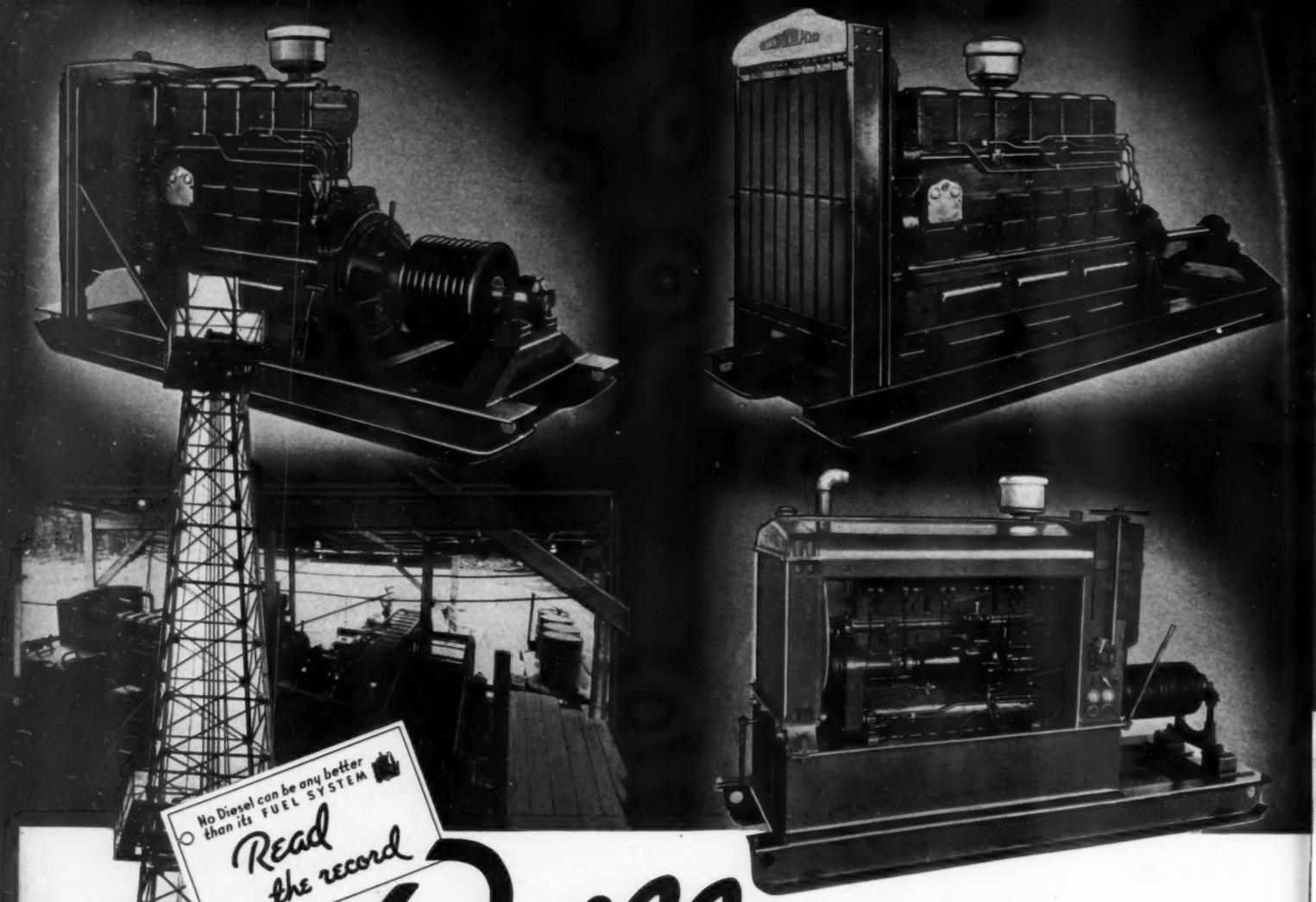
When you specify Lynite pistons of Alcoa Aluminum alloys, you specify the uniform dependability of volume production, and you get the reliability that only Aluminum can deliver in Diesel pistons.

ALUMINUM COMPANY OF AMERICA, 2141 Gulf Building, Pittsburgh, Pennsylvania.

Be sure ··· **THE PISTONS ARE**

LYNITE PISTONS

CAST OF ALCOA ALUMINUM



No Diesel can be any better than its FUEL SYSTEM

Read the record

Drillers SPECIFY THESE ENGINES

● *You owe it to yourself to know why the Cummins Diesel is different from any other Diesel . . . Send for new Bulletin FS-100. It gives the answer.*

For rotary deep-well drilling, where speed and flexibility combined with proven dependability are always in demand, and where good service is of the utmost importance, shrewd drillers specify the Cummins Diesel.

Cold starting in any weather, quick acceleration, economical in both fuel and water . . . the Cummins Diesel gives the lowest drilling cost per foot of hole.

CUMMINS DIESELS

CUMMINS ENGINE CO., 1009 WILSON ST., COLUMBUS, IND.

DIESEL *OVERHAUL* COST CUT 90% *with* SINCLAIR TEN-OL

IN heavy duty, high-output laboratory tests, "Caterpillar" Diesel engines were operated 2000 hours lubricated with high grade straight mineral oil, and also with Sinclair Ten-ol. After the tests, measurements revealed that the wear on cylinder liners of the engines lubricated with Sinclair Ten-ol was less than 1/10 the liner wear in engines lubricated with high grade straight mineral oil.

That is just one of the newly developed facts which show that your "Caterpillar" Diesel overhaul cost will be 90% less if you use Sinclair Ten-ol. Ten-ol is an alloyed lubricant recently developed for "Caterpillar" Diesels by Sinclair Refining Company. It is recommended as a "new outstanding Diesel engine lubricant" by the Caterpillar Tractor Company.

Order Sinclair Ten-ol, Sinclair Diesel fuel and other Sinclair products from your local Sinclair office or write to Sinclair Refining Company (Inc.), 630 Fifth Avenue, New York City.

Copyrighted, 1931, by Sinclair Refining Company (Inc.)

1

The finest grade of straight mineral oil was used to lubricate the "Caterpillar" Diesel from which this piston was removed after an accelerated operation test. Note evidence of excessive blow-by, carbon-coated piston crown, sludge, plugged oil control rings and gum on piston skirt. Wear on liners is excessive.

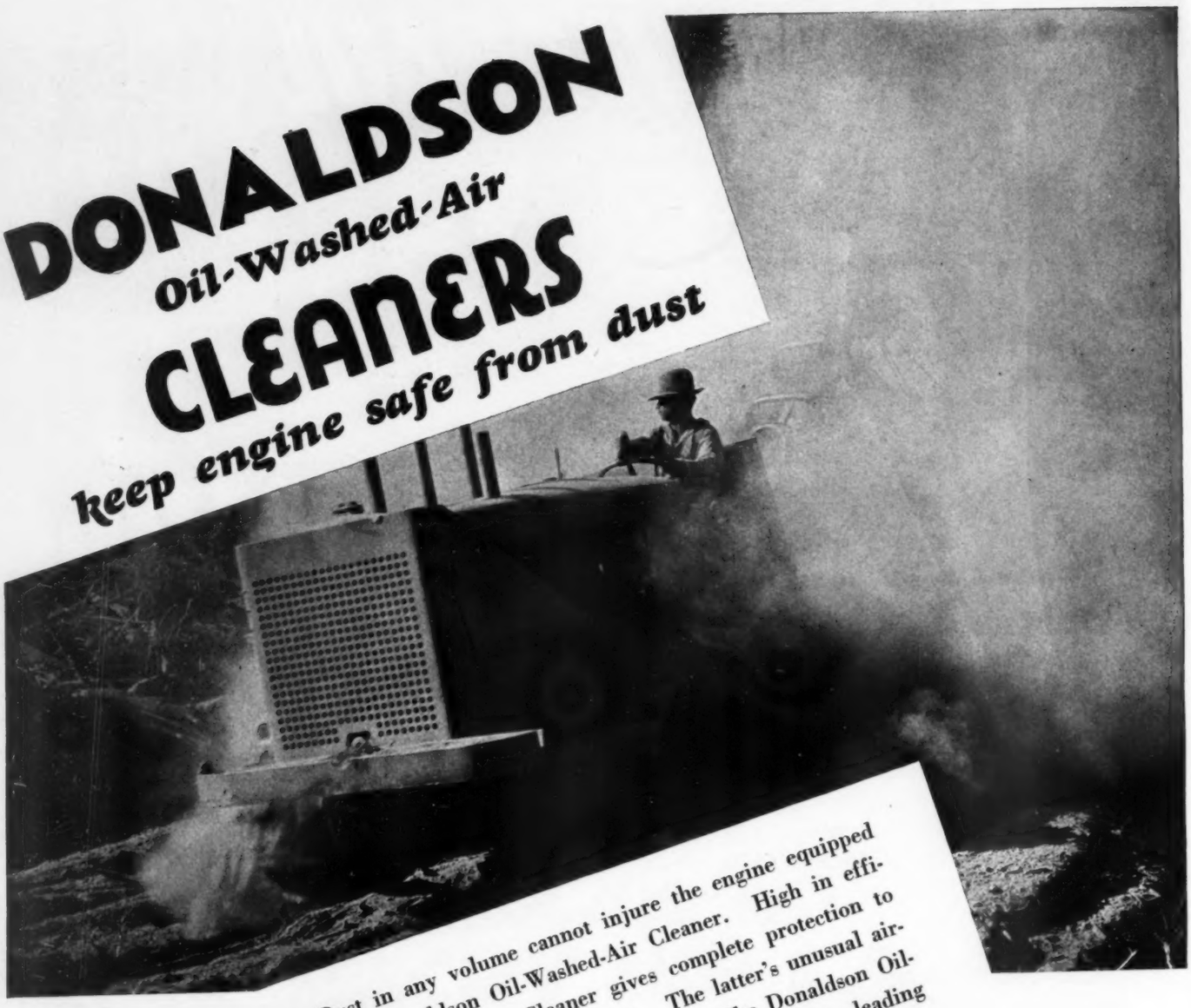
(An unretouched photo)

2

Sinclair Ten-ol lubricated the "Caterpillar" Diesel from which this piston was removed after an accelerated operation test ten times as long as the one on the left. Note absence of ring sticking, perfect condition of oil control rings, freedom from blow-by and absence of gum on piston skirt. Ring and liner wear are negligible.

(An unretouched photo)

DONALDSON
Oil-Washed-Air
CLEANERS
keep engine safe from dust



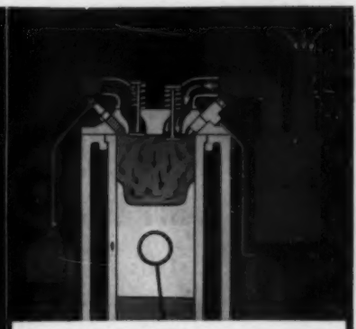
• Dust in any volume cannot injure the engine equipped with a Donaldson Oil-Washed-Air Cleaner. High in efficiency, this popular Cleaner gives complete protection to either gasoline or Diesel engines. The latter's unusual air-flow requirements are met with ease. The Donaldson Oil-Washed-Air Cleaner is standard equipment on leading makes of tractors and power machinery for field and industrial uses, BECAUSE it has proved itself essential to UNINTERRUPTED engine service. . . . If your product needs dust protection, our consulting engineers will be glad to work out the particular type of Donaldson Oil-Washed-Air Cleaner best suited to the job. Write us!

DONALDSON COMPANY, INC.

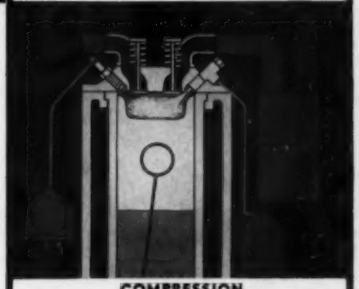
666 PELHAM STREET • ST. PAUL, MINNESOTA

ONLY ALLIS-CHALMERS *Gives you* THIS IMPROVED PRINCIPLE OF ENGINE OPERATION

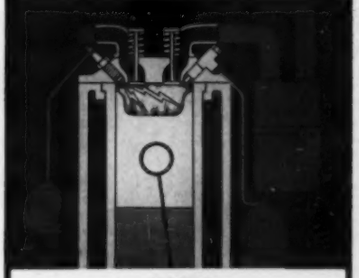
MODEL L-O 90 POWER UNIT
107 Maximum Brake H. P. and 85
Continuous H. P. at 1050 R. P. M.



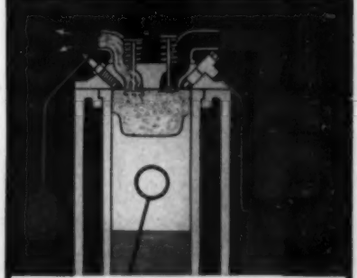
INTAKE
A measured quantity of cleaned air is drawn into the combustion chamber. The quantity is varied according to engine load by the governor.



COMPRESSION
The air is next compressed to approximately 160 pounds pressure. 60° before top dead center Diesel fuel is injected and thoroughly mixed with the air.



POWER
The mixture is next ignited by a spark from the magneto. Smooth, even power is delivered because of the gradual burning of the fuel charge.



EXHAUST
The exhaust valve opens and the burned gas is expelled from the cylinder in exactly the same manner as in a regular gasoline burning engine.

Controlled Ignition OF DIESEL FUEL OIL

IN Allis-Chalmers Controlled Ignition Oil Engines, the economy of Diesel fuel oil has been COMBINED for the first time with the smoothness, instant starting, reliability and simplicity generally associated only with gasoline engines. Controlled Ignition eliminates high compression pressures. This means less vibration and crankshaft whip . . . less wear and tear . . . less strain on working parts . . . freedom from terrific heat . . . fewer repairs. No high tension rings are required . . . no special high pressure bearings . . . no heat reservoirs in the combustion chamber . . . no special lubricating oil. Special grades of fuel are unnecessary—the Controlled Ignition Oil Engine burns any good grade of Diesel fuel oil. No auxiliary starting motor is needed —starts on a mixture of gasoline and Diesel fuel oil—without undue strain on reciprocating parts. Costly dead weight is eliminated—which means more efficiency and greater economy. Investigate this improved engine principle! Write for booklet or ask the Allis-Chalmers dealer.

ALLIS-CHALMERS

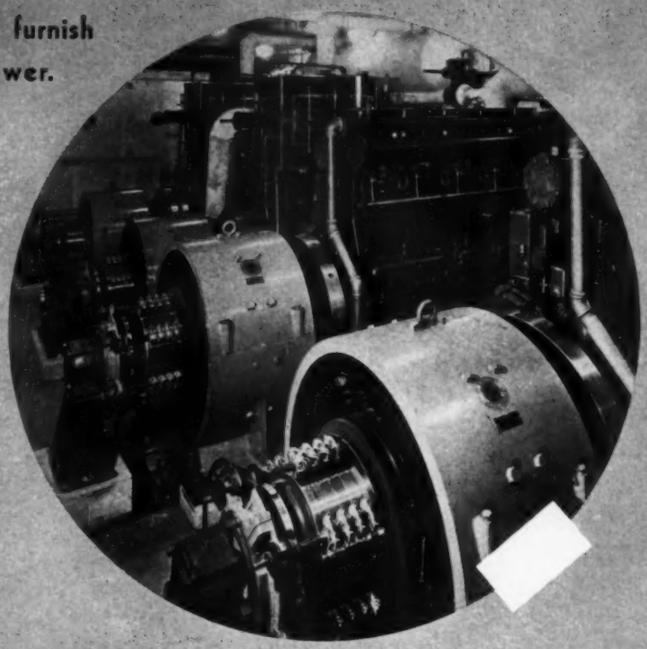
TRACTOR DIVISION—MILWAUKEE, U. S. A.

CONTROLLED IGNITION OIL ENGINES

In New York City the

EMPIRE TRUST BUILDING

installs four Crocker-Wheeler three-wire generators to furnish light and power.



THE lower voltage required for lighting is generated by means of an additional winding placed on the generator armature. This construction has four important advantages over the ordinary three-wire generator:

1. Higher efficiency — because transformers (with their attendant losses) are eliminated.
2. Simplicity — there are few parts to get out of order.
3. Less complicated wiring—both internal and external.
4. Greater compactness — an important consideration where floor space is limited.

CROCKER-WHEELER ELEC. MFG. CO.

Main Office and Works: AMPERE, N. J.

SALES OFFICES IN PRINCIPAL CITIES

CROCKER-WHEELER

EXCELLENT ENGINEERING

"HALF A MILLION COMBINATIONS OF THESE—

It is Socony-Vacuum's job...through its Engineering Service... to provide 'Correct Lubrication' for 500,000 different applications of bearings...gears...cylinders."

What this Exclusive Service can do for your Plant:

1. **Curb losses that boost power consumption and costs.**
2. **Decrease maintenance—eliminate unnecessary repair bills.**
3. **Improve production results by greater machine efficiency.**
4. **Lower lubrication costs.**
5. **Help your men find ways to devise important economies.**

IT TAKES A GREAT, highly trained organization to keep fully up to date on half a million different varieties of vital mechanisms. That's been the job of the makers of Gargoyle Lubricants for the past 71 years.

Hundreds of thousands of industrial men . . . executives, plant managers, machine hands . . . find that this exclusive element of Socony-Vacuum's Service to Industry helps to make plant operations profitable.

TAKE JUST a few minutes to talk with a Socony-Vacuum representative . . . let our experience work among your capable plant men.

SOCONY-VACUUM

INDUSTRIAL LUBRICATION

GARGOYLE Lubricants

SAVES MONEY FOR INDUSTRY

71 Years' Lubricating Experience...the Greatest in the Oil Business

What more convincing proof?

RELIABILITY

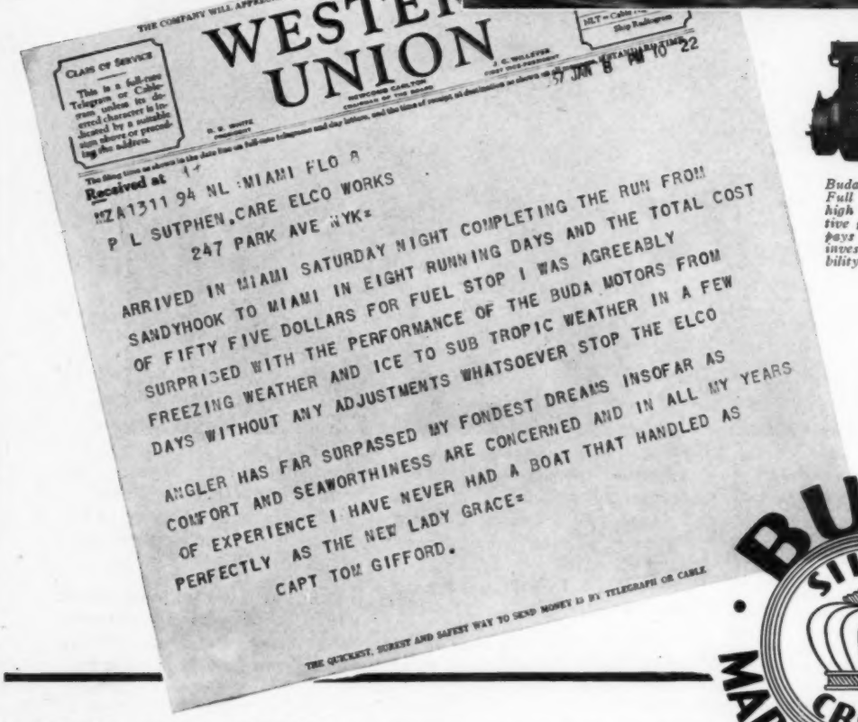
1400 Miles in 8 days—Sandy Hook, New Jersey to Miami, Florida.

TEMPERATURE RANGE

From frigid to tropical weather without adjustments.

ECONOMY

Total fuel cost for TWO BUDA DIESELS only $55.



WESTERN UNION

CLASS OF SERVICE

This is a full-rate Telegram or Cable-gram unless its class is indicated by a suitable symbol above or preceding the address.

Received at

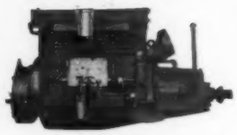
MZA1311 94 NL MIAMI FLO 8

P L SUTPHEN, CARE ELCO WORKS
247 PARK AVE NYK=

ARRIVED IN MIAMI SATURDAY NIGHT COMPLETING THE RUN FROM SANDYHOOK TO MIAMI IN EIGHT RUNNING DAYS AND THE TOTAL COST OF FIFTY FIVE DOLLARS FOR FUEL STOP I WAS AGREEABLY SURPRISED WITH THE PERFORMANCE OF THE BUDA MOTORS FROM FREEZING WEATHER AND ICE TO SUB TROPIC WEATHER IN A FEW DAYS WITHOUT ANY ADJUSTMENTS WHATSOEVER STOP THE ELCO ANGLER HAS FAR SURPASSED MY FONDEST DREAMS INSOFAR AS COMFORT AND SEAWORTHINESS ARE CONCERNED AND IN ALL MY YEARS OF EXPERIENCE I HAVE NEVER HAD A BOAT THAT HANDLED AS PERFECTLY AS THE NEW LADY GRACE=

CAPT TOM GIFFORD.

THE QUICKEST, SUREST AND SAFEST WAY TO SEND MONEY IS BY TELEGRAPH OR CABLE



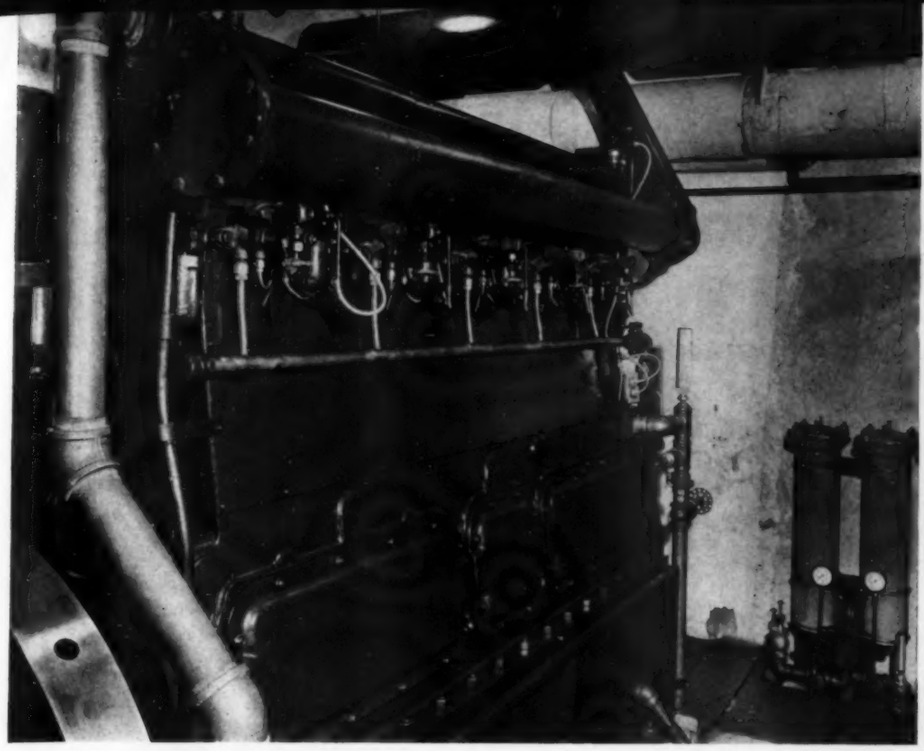
Buda-Lanova "Silver Crown" Full Diesel Marine Engine, high "workable" mean effective pressure. The engine that pays YOU dividends on your investment in safety, reliability, and low operating costs.

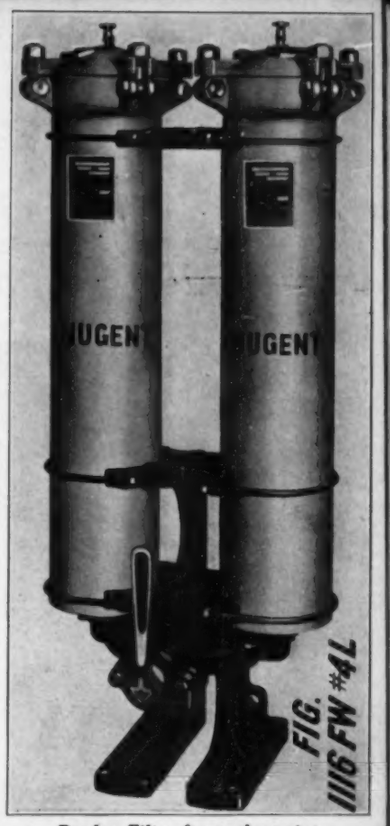
BUDA SILVER CROWN MARINE ENGINES

Gasoline Engines from 25 to 125 H.P. Diesel Engines from 32 to 200 H.P.

CAPTAIN TOM GIFFORD, recognized as one of the World's Greatest Sport Fishermen, knows boats and knows Diesel Engines, due to his former experience in the U. S. Navy. His new Elco Angler *Lady Grace*, built by Elco Works, Bayonne, New Jersey, is 36′ 6″ x 10′ 10″ x 2′ 10″, and is powered with a pair of Buda 6-LDM-415 six-cylinder Diesel Engines rated at 75 to 95 H.P. They drive his boat at 16 to 17 m.p.h. Fuel tank capacity is 300 gallons and the *Lady Grace* can cruise 600 miles on both of her engines or 800 miles on one of them.

THE BUDA CO. Marine Eng. Div. K, Harvey (CHICAGO SUBURB), Ill.





Duplex Filter for each engine

NUGENT Oil Filters
Large Filtering Area

(Patented)

- Were selected for the two INGERSOLL-RAND 150 KW Diesel engines in the EMPIRE TRUST SKYSCRAPER.

BECAUSE of the excessively large filtering area per floor space occupied. Eliminates frequent cleaning.

BECAUSE they have no moving parts to replace and repair.

BECAUSE the initial cost per square inch of filtering area is many times less than any other filter made.

BECAUSE the extraction of erosives, carbon and non-precipitating substances is accomplished by the only successful method known to science and practice, and is being demonstrated by the many replacements of other makes of so-called filters.

BECAUSE they will produce 99 8-10 per cent clean oil.

Nugent Duplex Lubricating Oil Filter for each engine.

All the oil before circulated to the bearings and cylinders is filtered every cycle. All dirt, carbon and abrasives are removed as soon as they get into the oil. Sludge and frequent oil changes are eliminated or reduced.

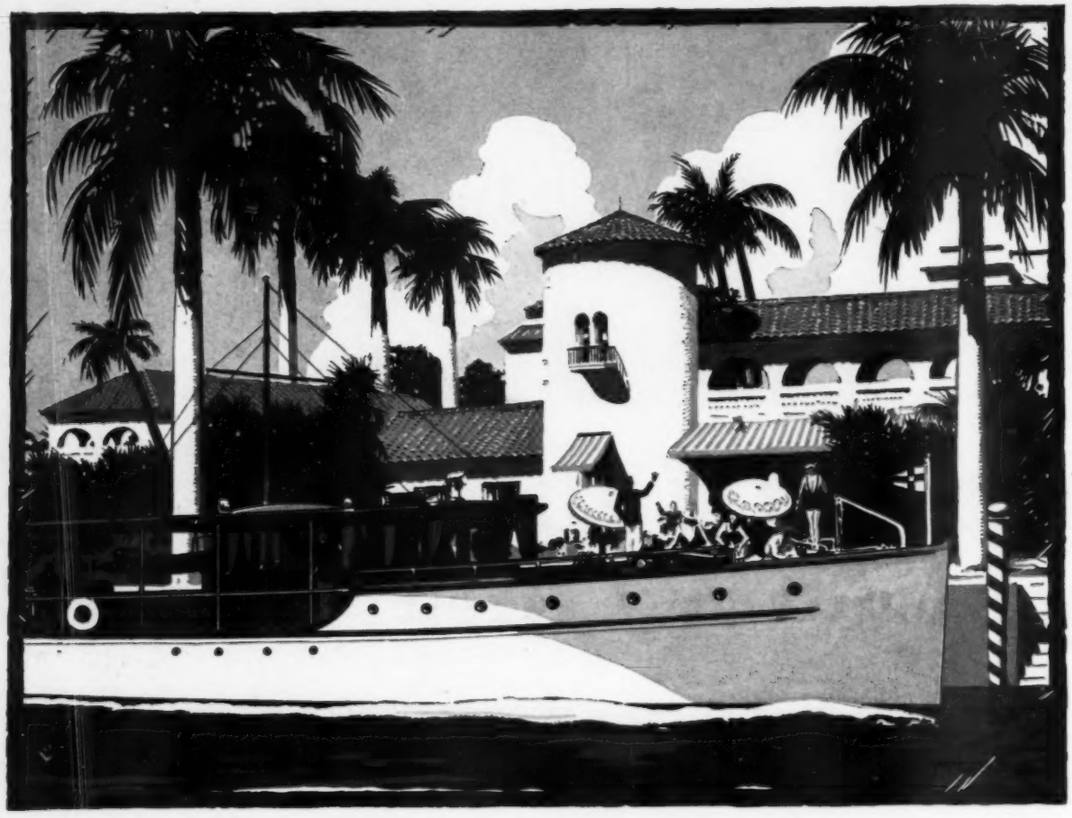
Write for Bulletin 7A

Wm. W. Nugent & Co., Inc. Mfrs.

Oil Filters, Oiling and Filtering Systems, Telescopic Oilers, Oiling Devices, Sight Feed Valves, Flow Indicators, Compression Union Fittings, Oil Pumps, Etc.

415 N. Hermitage Ave. Established 1897 Chicago, U. S. A.

HERCULES POWER CHOSEN BY LEADING MARINE ENGINE MANUFACTURERS



While Hercules does not make complete marine power plants, Hercules Engines are used today by many leading marine-engine manufacturers. The manufacturers who choose Hercules Engines—either gasoline or Diesel—select them for compact design, dependability and long life. Marine engines must have those qualities—must be relied upon in fair weather or foul. And those qualities result from over twenty years' experience in designing and building heavy-duty engines for every purpose. This experience is at the service of commercial and pleasure boat as well as marine-engine builders.

Hercules Marine Diesel Engines supplied by Kermath Manufacturing Company, Detroit, Michigan

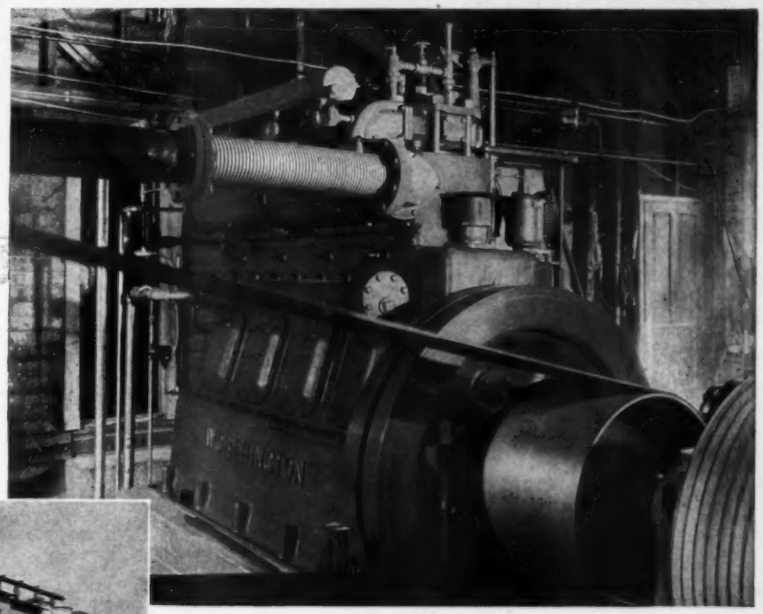
HERCULES DIESEL ENGINES

HERCULES MOTORS CORPORATION, CANTON, OHIO

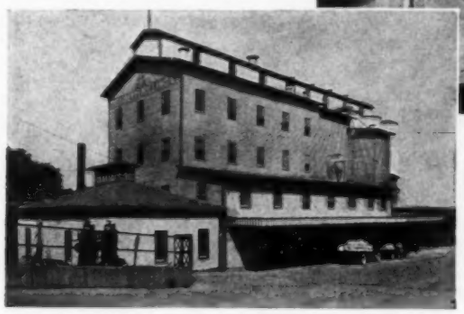
America's Foremost Engine Manufacturer • Power Plants from 4 to 200 H. P.

For GREATER POWER ECONOMY
a progressive milling company
SELECTS A WORTHINGTON DIESEL

Worthington 200-horse-power Diesel Engine at the Liberty Milling Company, Germantown, Maryland



The Liberty Milling Company plant. A. R. Selby, Treasurer and General Manager



● TO MANUFACTURERS IN EVERY FIELD...

Worthington offers the services of an organization unsurpassed in its ability to analyze correctly any power problem...with more than 35 years of successful engine building and application experience to support its recommendations.

DIESEL ENGINES...25 to 1500 hp.
For any type of drive

● *Bulletins available*

To accomplish necessary expansion of and further economies in its power requirements, this forward-looking milling company...already experienced with Diesel and other forms of power...selected a Worthington Diesel after thorough investigation brought out convincing records for its maintained economy and trouble-free operation.

...and here, one more Worthington Diesel is adding to the enviable reputation of hundreds already in long service in many applications.

WORTHINGTON PUMP AND MACHINERY CORPORATION

General Offices: **HARRISON, NEW JERSEY** • *Branch Offices and Representatives in Principal Cities throughout the World*

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WOODWARD

GOVERNORS *for* DIESELS

Included in Over Five Hundred Type IC Governor Applications are the Diesel Power Plants of New York University and Zinsser & Company, Inc., Featured in This Issue of Diesel Progress

WOODWARD HYDRAULIC GOVERNORS FOR PRIME MOVERS

SHIPPED OR ON ORDER

DURING THE YEAR 1936 ALONE

WILL CONTROL

2,622,000 HORSEPOWER

TYPE IC GOVERNORS, ESPECIALLY DESIGNED AND BUILT FOR APPLICATION TO INTERNAL COMBUSTION ENGINES IN STATIONARY ALTERNATING CURRENT SERVICE, ARE IN USE IN MAJOR DIESEL POWER PLANTS THROUGHOUT THE UNITED STATES AND MANY FOREIGN COUNTRIES; ARE SPECIFIED FOR THIS SERVICE BY LEADING CONSULTING ENGINEERS; AND ARE AVAILABLE ON, OR CAN BE ADAPTED TO, ALMOST ANY MAKE OF DIESEL. TO INSURE YOUR CUSTOMERS THE BENEFITS OF ACCURATE TIMEKEEPING AND UNIFORM PRODUCTION, RESULTING FROM PRECISE FREQUENCY CONTROL, SPECIFY WOODWARD TYPE IC GOVERNORS FOR THE ENGINES IN YOUR PLANT. » »

WOODWARD GOVERNOR CO.

WORLD'S OLDEST AND LARGEST EXCLUSIVE MANUFACTURERS OF HYDRAULIC GOVERNORS FOR PRIME MOVERS

ROCKFORD, ILLINOIS

No. 4 of a series showing the scope of Westinghouse Electrical Applications in Diesel Power Plants.

Secure this 3 WAY GUARANTEE *with* WESTINGHOUSE COMPLETE ELECTRICAL EQUIPMENT

★

NEAR MATEHUALA, MEXICO—Power House of the Compania Minera Kildun y Anexas . . . WESTINGHOUSE ENGINE GENERATORS, driven by INGERSOLL-RAND DIESELS.

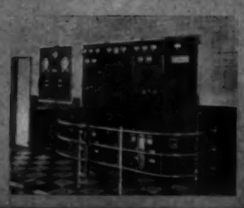
Guarantee LIFETIME SATISFACTION

There is no safer way to guarantee lifetime satisfaction from your Diesel power plant than by specifying Westinghouse complete electrical equipment.

ES GENERATORS—Especially designed for lifetime operation in Diesel Service, with these extra values: *Solid Steel Rotor*, to withstand severest screams under all conditions. *Protection against Shut-downs*, insured by exclusive high frequency pre-testing. *Positive Ventilation*, for cool running and long life.

EXCITERS—Either direct-connected or belt-driven, as required.

MOTORS—With dual-protected windings, rigid cast frames, and sealed-sleeve bearings . . . for driving compressors and other auxiliaries.



COMPLETE SWITCHBOARD ACCESSORIES—For every requirement—instruments, instrument transformers, switchgear, circuit breakers, relays.

To those who contemplate the installation of Diesel-electric power systems, Westinghouse makes this suggestion—secure this 3-Way Guarantee:

(1) *The guarantee of undivided responsibility.* Westinghouse is qualified, willing and able to provide complete electrical equipment for Diesel-power plants, thus facilitating negotiations and concentrating responsibility for the electrical installation in one dependable source.

(2) *The guarantee of matched performance.* Westinghouse experience goes back to the first engine generators produced in this country. It includes applications especially designed for Diesel power units, such as generators, exciters, motors and switchboard accessories—all co-ordinated in design to give matched performance—and all designed in turn to match the requirements of Diesel engine drives.

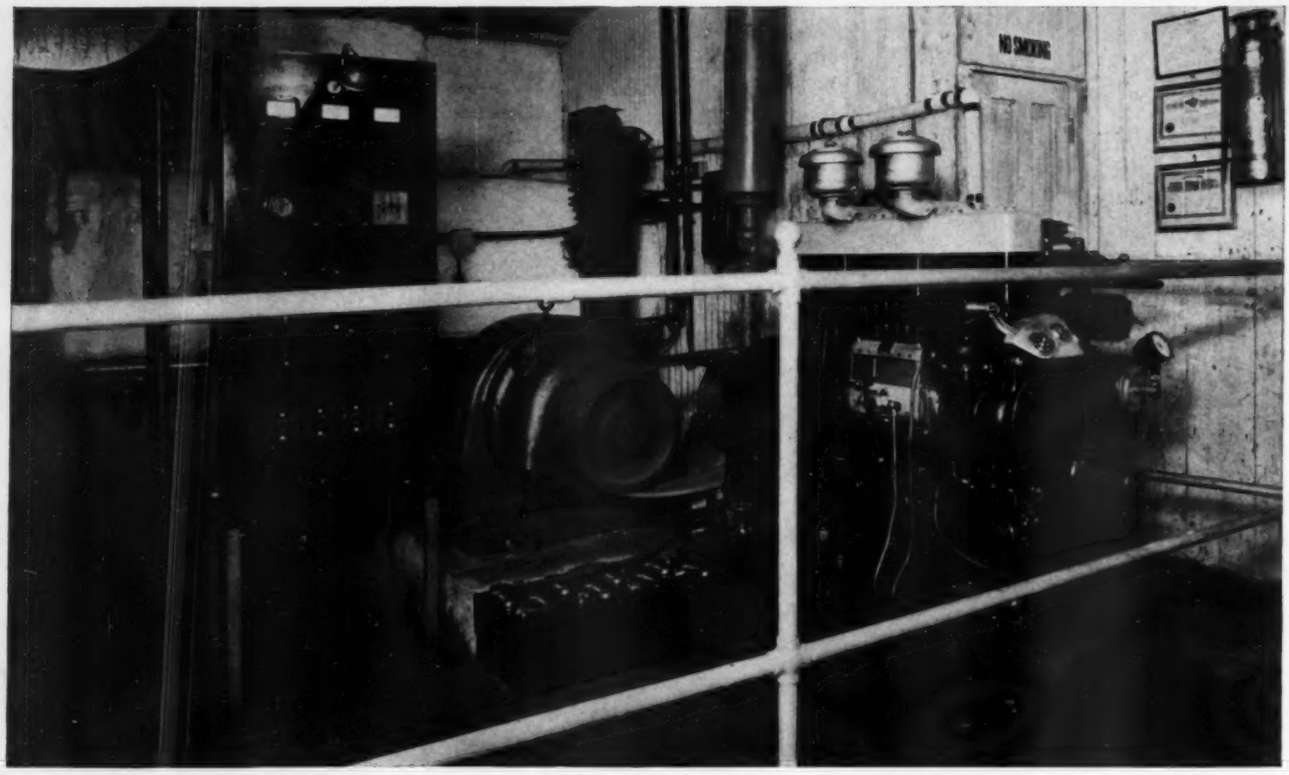
(3) *The guarantee of service.* With nationwide service facilities, concentrated in 37 Westinghouse service shops manned by factory-trained experts, Westinghouse is in a position to guarantee prompt and efficient service on a day's notice or less.

Secure these benefits, specify *complete Westinghouse electrical equipment.*

J 10014

Westinghouse

ENGINE-DRIVEN GENERATORS AND ELECTRICAL AUXILIARIES



Converting Expense to Profit

◆ This Superior Model IA-6, 62 H.P. Diesel and 40 K.W. Generator in the American Laundry, Trenton, New Jersey, is saving them 70% on their power bill by producing electric current at less than 7/10 of a cent per K.W. It is also heating water for a further savings of more than $30.00 per month.

Ice plants, dairies, hatcheries, gravel plants, filling stations, garages, restaurants, hotels, and many other power users have found the Superior Diesel Engine a simple and thoroughly reliable means of reducing power and lighting bills.

THE NATIONAL SUPPLY COMPANY
OF DELAWARE
SUPERIOR ENGINE DIVISION
LOS ANGELES, CALIFORNIA SPRINGFIELD, OHIO PHILADELPHIA, PA.

Superior DIESELS

HEAVY DUTY MODELS: 50 to 810 H.P., 250 to 720 R.P.M. • HIGH SPEED MODELS: 25 to 150 H.P., 1200 to 1800 R.P.M.

REPORT ✓
VIBRATION DISAPPEARED

REPORT ✓
LOWERED WATER TEMPERATURE

REPORT ✓
EXHAUST TEMPERATURE 27° LOWER

REPORT ✓
INCREASED 16 REVOLUTIONS PER MINUTE

REPORT ✓
FREE OF ANY CARBON DEPOSITS

REPORT ✓
LESSENED OPERATING LABOR

J. HOWARD SMITH
BOAT "*STERLING*" • FERNANDINA, FLORIDA

Mr. C. M. Bennett,
2789 Riverside Avenue,
Jacksonville, Florida.

August 4, 1936

Dear Sir:

Replying to your inquiry as to the performance of the Diesel Engine that I operate, using Ring-free Oil as a lubricant, is going to require quite a lengthy letter but I will try to be as brief as possible.

My experience with Fairbanks-Morse Diesel motors in fishing vessels has been considerable and over a long number of years. Up until you sold my employer Ring-free Oil I had been inclined to blame operation and carbon troubles on the Diesel but since using Ring-free Oil I have learned that it was oil, and not the motor, that was at fault.

✓ ✓ ✓ ✓ After changing to Ring-free the vibration of the motor at slow speeds continuously diminished until it has entirely disappeared; my circulating water temperatures lowered until I had to choke back on the flow of water through the jackets. My exhaust port temperatures according to Alnor Pyrometer have lowered 27 degrees without any change in the fuel pump adjustment. My engine speed at an exact marked throttle setting has increased 16 revolutions per minute. ✓ Recently, upon examination of the exhaust ports in the exhaust manifold, I found that they were entirely clean and free of any carbon deposits, except a very light, dry lamp black-like substance. Remembering your claim that my bases would be cleaner, I removed the base plates and found the bases so clean that the red lead anti-rust paint was as plain to be seen as though it were a new engine.

I can assure you that when you first attempted to sell me upon the idea of using Ring-free Oil I was convinced that there could not be a word of truth in any of your claims. Since using it I find that you were rather conservative in describing what the oil would do, and I can say truthfully that I would much prefer not to ever run a Diesel again if I could not have Ring-free Oil to lubricate it.

✓ May I thank you for the lessened labor that occurs in operating our Fairbanks-Morse Diesel engine with your Ring-free Oil.

Respectfully yours,

Douglas Whitehurst

Douglas Whitehurst, Chief Engineer,
Boat "STERLING,"
Fernandina,
Florida.

MACMILLAN RING-FREE MOTOR OIL

1. GREATER FILM STRENGTH
2. HIGHER HEAT RESISTANCE
3. LONGER CLING TO METAL
4. FASTER PENETRATION
5. REMOVES HARD CARBON
6. IS NOT CORROSIVE

Results speak louder than words. Mr. Whitehurst's experience with this oil in a Diesel is typical of hundreds of other cases. A short trial test in your own Diesel will convince you that this oil opens the way to lower operating costs, reduced wear and repair, and to more power for your money. **Macmillan Petroleum Corporation, 530 West 6th Street, Los Angeles, Cal., or El Dorado, Ark.**

MEET THE MACMILLAN MAN – LET HIM SHOW YOU PROOF

International Diesel

Provides Uniform Power for Quality Ginning of Long-Staple Cotton

Above: The International PD-40 Diesel Power Unit.

Below: Exterior of the building housing the gin on the Martingayle plantation.

The 80-saw 2-stand cotton gin on the Martingayle plantation which is driven by the International PD-40 Diesel Power Unit.

A SMOOTH, unvarying flow of power is essential to the successful ginning of long-staple cotton, according to J. T. Martin, owner of the Martingayle plantation, about 28 miles from Montgomery, Ala. Production of long-staple cotton and pedigreed cotton seed is his main business.

In 1933 he investigated the International PD-40 Diesel Power Unit. He was satisfied as to its troubleproof construction, power, and fuel economy, but he had to be shown that it would deliver the constant power required to drive his gin which is an 80-saw 2-stand type especially designed for long-staple cotton. The International Diesel gave him the kind of power he needed, after installing it, and at the end of the first season's run, he wrote:

"The speed on the shaft of the gin was set at 400 r.p.m. We asked that the engine deliver the required horsepower, 58 at the peak load, without a drop of more than 5 to 6 r.p.m. The speed on the shaft was tested every day, and throughout the season we maintained a very steady speed and the r.p.m stayed between 403 and 409."

The International Diesel brought economy as well as the performance he wanted. In one season Mr. Martin ginned 483 bales at an average fuel cost per bale of 17.3 cents, using 8-cent fuel. The next year 724 bales were ginned at an average fuel cost of 12.8 cents. The cost could be reduced further by increasing the speed of the gin but he prefers to operate it at a lower speed and maintain the highest quality.

For the scale of his ginning operations, Mr. Martin believes the International PD-40 Diesel is the most efficient and economical power it is possible to buy. His experience with International is similar to other users in every field. Investigate International Diesel Power Units for your own work. The nearby Company-owned branch or industrial dealer will give you complete information.

INTERNATIONAL HARVESTER COMPANY
(Incorporated)
606 So. Michigan Ave. Chicago, Illinois

INTERNATIONAL Industrial Power

America's Largest 1936 Industrial Diesel Plant Served by "ALNOR" Exhaust Pyrometers

THE largest industrial Diesel installation made in 1936 is The Ludlow Manufacturing & Sales Company plant at Edge Moor, Delaware.

This plant consists of three 1,000 hp. 4-cycle mechanical injection type Winton Diesel engines of 8 cylinders each connected to 700 kw. alternating current generator.

Each of these main Diesels are provided with separate control equipment including an Alnor Model RB Exhaust Pyrometer mounted conveniently above a stand and table, with a log book in which a permanent and continuous operating record is recorded. The view at left shows the operating instruments and gauges including the "Alnor" Pyrometer.

Alnor Exhaust Pyrometers, because of their moderate price, attractive appearance, accuracy, and proved reliability, are the choice of Diesel engine manufacturers, consulting engineers and users throughout the World.

"Alnor" Model RB Exhaust Pyrometer like those installed at Ludlow.
CHAS. T. MAIN, INC., Boston
Consulting Engineers.
GUSTAVO PRESTON CO., Boston
Winton Distributors

Write for Complete Catalog

ILLINOIS TESTING LABORATORIES, Inc.
423 North LaSalle Street • Chicago, Illinois

Testing Engineers and Manufacturers of "Alnor" and "Price" Measuring Instruments.
Products of 37 years' Experience.

"Alnor" Pyrometers—*The Engine X-Ray*

IT KEEPS THEM *at their best*

To get the most out of Diesels, look to the lubricating oil they get. Using Texaco Algol or Ursa, you will cut need for overhauling to the absolute minimum. Ask the Texaco representative about them.

YOUR DIESELS can give you top performance . . . only when you meet their lubrication needs.

The oil you select for Diesel cylinder lubrication should be wholly distilled, carefully filtered, and free from carbon and sludge forming elements.

With Texaco Algol or Ursa Oils in your Diesels, piston rings and valves will keep free-acting, ports will stay clean, compression will be maintained. As a result, you'll get greatly improved fuel economy.

Put Algol or Ursa in a single unit . . . and get the surprise of your life at inspection periods when you see how clean your engine stays. Users report getting twice the service from these Texaco Oils that they got with previously-used oils. *That's* a saving.

We, ourselves, operate more than 50,000 h.p. in Diesels. We *know* that Algol and Ursa Oils will do for you what they do for us. Try them and be convinced.

A Texaco representative will gladly provide practical engineering service to prove the economies of Texaco Products.

THE TEXAS COMPANY • 135 East 42nd St., N. Y. C.

Nation-wide distribution facilities assure prompt delivery

TEXACO *Lubricants for all types of Diesels*

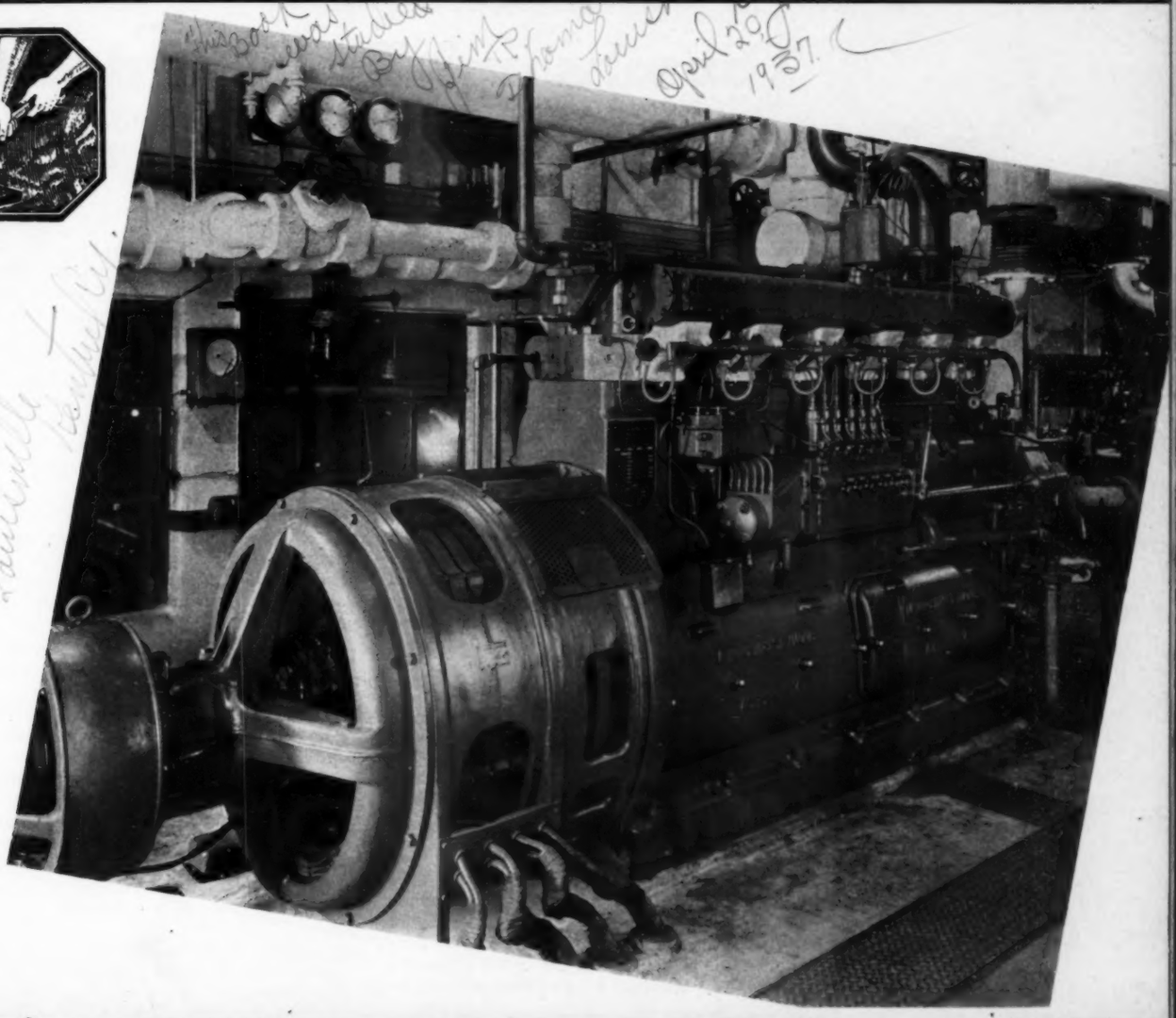
SATCO GOES BACK TO SCHOOL

THE picture below shows a 300 hp. high-speed McIntosh & Seymour Diesel engine installed in the new power plant of New York University. It is equipped with Satco* bearings.

In heading this message "Satco Goes Back to School" we do not mean to imply that this extraordinary bearing alloy has not learned the three R's — Resistance, Recuperation and Reliability. Satco not only knows these three essentials but daily demonstrates them. In the hard school of experience Satco has proved its resistance to stress and overload; it has proved its ability to return readily to a smooth surface after foreign matter roughens the lining; it has proved its reliability in numerous installations around the country.

If you want to know more about Satco drop us a line.

*A patented alloy manufactured by National Lead Company. Trademark registered.



AMERICAN BEARING CORPORATION

AFFILIATED WITH NATIONAL LEAD COMPANY

INDIANAPOLIS INDIANA

CENTRIFUGAL American Bearings FORCE

NO. 2 OF A SERIES

Thumbs up? Thumbs down?

Private Trade Schools

PRIVATE schools, developed by individual initiative, pioneered the field of practical trade instruction. Uncontrolled, and without outside supervision, some schools succeeded; countless more failed. Today there are many types of privately operated trade schools; some good, some bad, some even worse than bad. "Rack'-et-eering" entered this field, just as it has helped to poison so many others.

What about these private trade schools? Diesel trade schools, for example? Is there a need for such schools? Is there any real justification for their existence? Is it not the same as asking: Is there a need for education, for training? Even the oldest 'old-timer'—product of the 'school of hard knocks and practical experience'—admits the necessity for training. He frequently even wishes that some of his 'experts' now working for him could get some real, honest to goodness training. Why? Times have changed—progress has made mechanical products more complicated, more intricate—and men must know more and more to keep up with this mechanical progress. Yes, there very definitely is a need for trade education, for trade training.

Who is going to provide this training? Industry? They try—but to a very limited degree. It costs too much; and education is not their field. Public schools? Diesel is still too young; and public schools have not yet caught up with this growing industry in their training program. Private schools have been the answer to date.

How well are these private Diesel schools doing their job? Not very well; not nearly as well as they should and could do. Why? In answering this question, let us eliminate from our minds the 'rack'-et' schools. They are not interested in doing a good job; particularly if it interferes with profit earnings too much. But what about the honestly operated, legitimate private Diesel schools?

Private schools have been compelled to play a 'lone hand.' They have been looked upon with suspicion and skepticism; and frequently, this attitude has been more than justified. But what about those schools deserving of cooperation? Industry frequently criticizes the product of the private school—the trade school graduate. They point out where he falls short; where he falls down on the job.

Is it possible that this situation could be remedied to a considerable degree; that the trade school student could be better trained and come closer to meeting the requirements of the employer, if a closer relationship existed between Industry and those private schools that are sincerely attempting to train men to fit the needs of Industry?

If industry is to use the product of the private trade school, they should have something to say about the production of the product. They know their own needs better than any school can know them; they know their requirements of the men they hire as mechanics, operators or machinists.

They very definitely are in a position to contribute concrete suggestions and helpful advice that would enable willing trade school educators to improve their training programs. Manufacturers' engineers could provide many constructive recommendations regarding proper service instruction; employers could point out specific examples where trade school graduates are not adequately trained. Yes, there is much that could be gained by a closer relationship between Industry and deserving private trade schools.

•

Correspondence regarding the subjects covered in this series of articles will be welcomed.

•

NATIONAL SCHOOLS *was established in Los Angeles in 1905—have continued without interruption under the management of its founders, with a definite policy of honesty, sincerity and worthiness of purpose. Today, National Schools, representing a million dollar investment, offers sound, thorough instruction courses in Diesel and Gas Engine work, Radio and Electricity.*

NATIONAL SCHOOLS

4000 South Figueroa Street • Los Angeles, California

[PIONEERS OF PRACTICAL TRAINING FOR 32 YEARS]

DIESEL PROGRESS

REX W. WADMAN, Editor and Publisher

WASHINGTON, D. C., February 28th, 1937. The modernization of the American Merchant Marine is a vital national necessity and I look to see definite steps taken during this year to improve current conditions.

The Merchant Marine Act of 1936 decrees that no ship over twenty years old shall receive operating subsidies, except under very special conditions. This means new ships, ships which will be able to compete with modern foreign tonnage. Bear in mind that most of the American shipping now in service was built during the World War. Eighty-five per cent of our foreign trade fleet is fourteen years old or over, averaging seventeen years. Over 91 per cent of our domestic fleet (coastwise) is fourteen years old or older, averaging nineteen years. Even 88 per cent of our tanker fleet is fourteen years old or over, averaging eighteen years. Taken as a whole, approximately 88 per cent of our foreign, coastwise and tanker fleet (about 6,500,000 gross tons) is now fourteen years old or more and a million gross tons is already over twenty years old.

On that basis we've got to build a million gross tons a year for the next six years to keep our fleet under twenty years of age. This represents at least four times as much tonnage as we have been building annually of late years. But what kind of vessels are these new ships going to be? Diesel vessels or steamships? Here again we are woefully behind the rest of the world. In 1936 throughout the world 167 Motorships (over 1,000 tons gross) were completed, but not one was built in this country. There are now on order throughout the world some 350 large Motorships approximating two million gross tons – but none here.

For Diesel vessels of all types last year's launchings showed a net gain of nearly 50 per cent over the 1935 figures, the increase in volume amounting to almost 400,000 tons. For 1937 this increase in Motorship tonnage is even more marked, yet we do nothing about it over here. We Dieselize our small vessels, such as tugs, small tankers, ferries, river towboats, dredges, etc., but we stick to old fashioned steam for our big ships, what few of them we build. Why, I ask you, do we continue flouting the experience of the rest of the world?

Rex W. Wadman

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FRONT COVER ILLUSTRATION – An original impression of Diesel progress by the celebrated industrial artist, Charles Perry Weimer.

DIESEL PROGRESS for March, 1937, Vol. III, No. 3. Published monthly by Diesel Engines, Inc., 2 West 45th St., New York, N. Y. Tel. MUrray Hill 2-5092.

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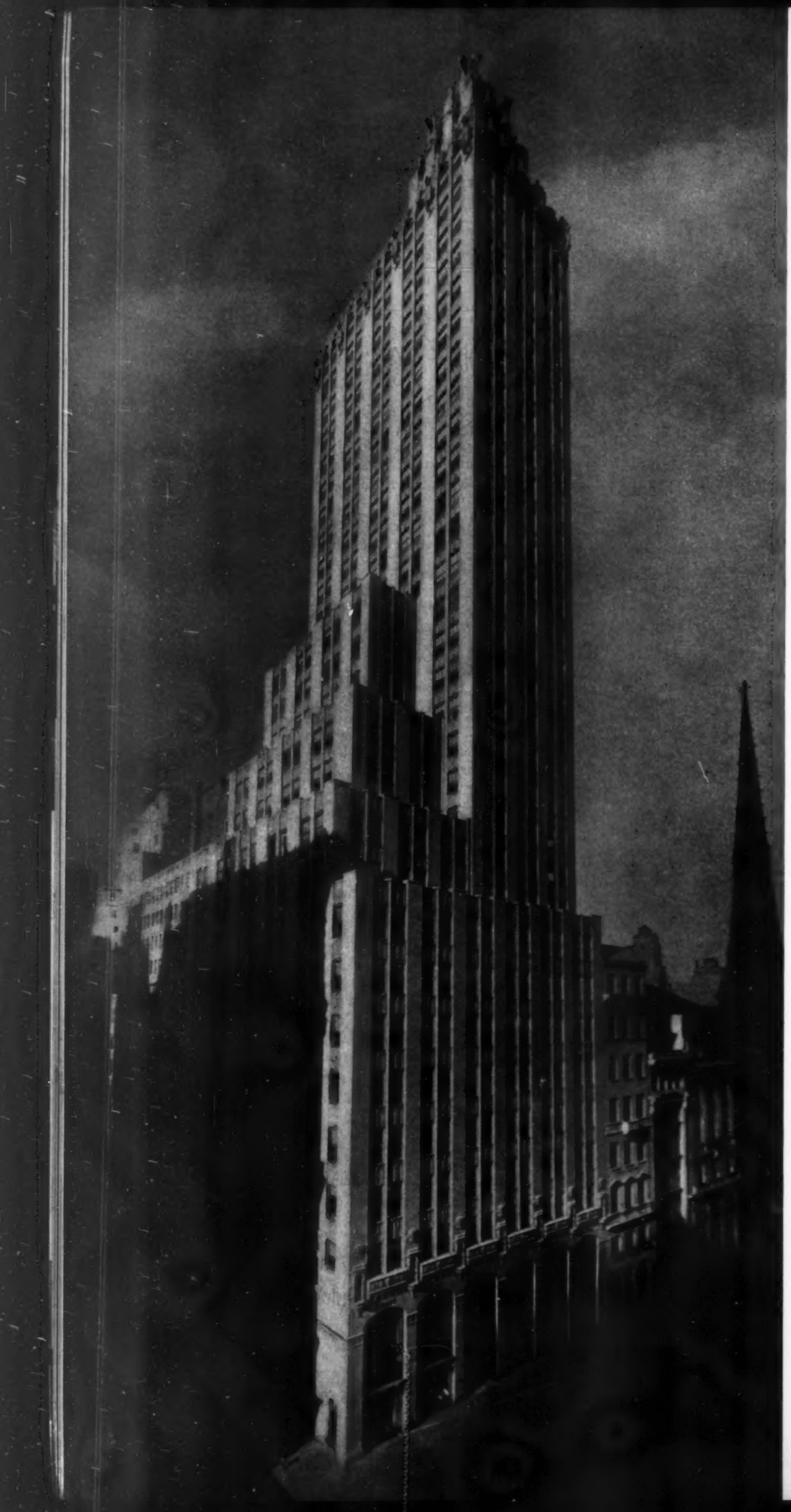

No. 580 FIFTH AV

IN THE CITY OF

By JOHN W. ANDERSON

IN the heart of New York's uptown business district on Fifth Avenue at 47th Street stands the Empire Trust Building. Adjacent to it on 47th Street is another building known as 27 West 47th Street. These two buildings are owned and operated as a unit by the same interests, and have as tenants such nationally known concerns as American Piano Corporation, Brentano's book store, Bulova Watch, and Devoe & Raynolds.

Previously these buildings have always purchased their requirements for the familiar three basic needs, light, power and heat, from the local utilities, but the necessity for greater economies prompted studies which resulted in the installation of their own power plant using a combination of steam and Diesel engines. That is the installation shown and described here. But let it be emphasized that there are three good reasons why there is economy in the new plant. First, the light, power and heat requirements were carefully determined. Second, a plant was designed and installed to be flexible enough to meet variations in daily, weekly, and seasonal requirements. Third, the operating personnel watches the loads, and operates the machinery so as to catch the benefit of every economy possible.

Although the plant has been in operation only a short time, the preliminary results show that the anticipated economies are being made. The new plant started to take over the building load on November 23rd last, and not until the 20th of December was it carrying the entire heating and electrical load. Consequently at this writing the results of only about a month's operation are available. The figures for one full month are given in the tabulation. Note the comparison with the actual figures obtained from last year's operation. In order to have as fair a comparison as possible, an arbitrary pro rata charge for maintenance has been taken which it is felt will more than cover the actual expenditures as and when they come. On the basis of the savings made, it is expected that the plant will pay for itself in about three and one half years.

TH AVENUE

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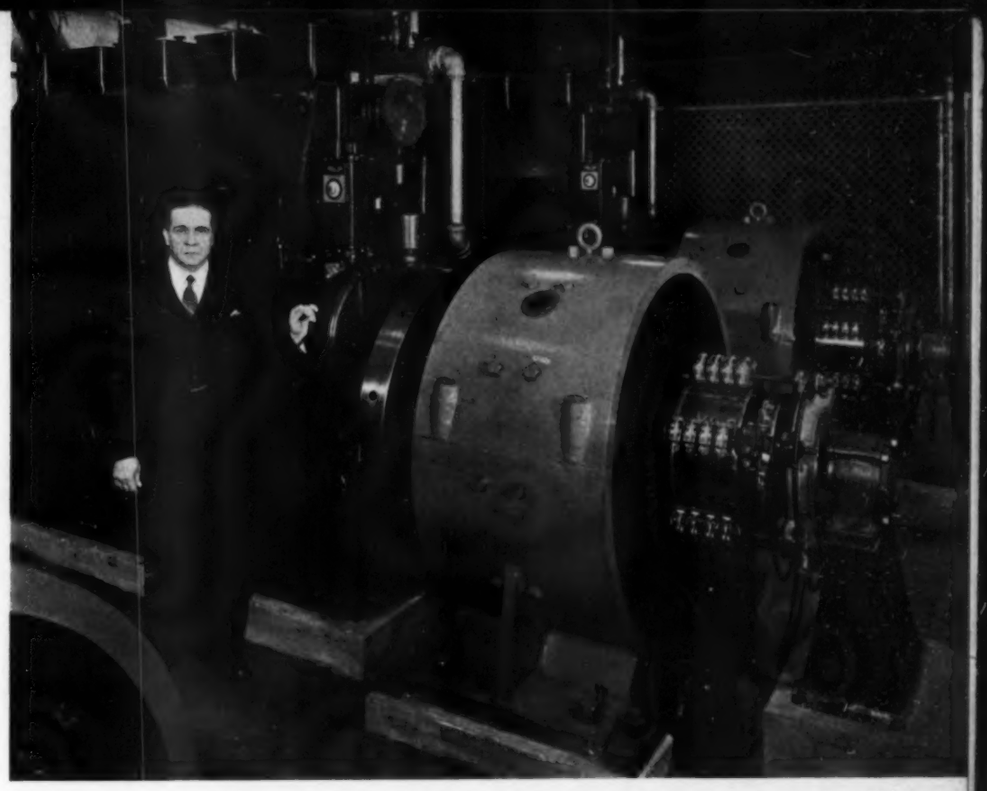


Mr. Harry J. Smith, Supervising Engineer, with his latest Diesel installation of two 150 kw. Ingersoll-Rand engines.

POWER PLANT REPORT

Dec. 23, 1936 to Jan. 23, 1937

Total Cost of Operation		$2,600.00
Divided as Follows		
Steam Heating and Hot Water		
Fuel Oil 40,000 Gals.	$1,240.00	
Labor	360.00	
Maint.	30.00	
Total		$1,630.00
Electricity		
Diesel Oil 6,000 Gals.	$330.00	
Labor	460.00	
Maint. & Lub. Oil	150.00	
Ins.	30.00	
Total		$ 970.00
Steam cost us for same period last year		$3,004.09
Our cost this year		1,630.00
Saving		$1,374.09
Total kw.'s Generated 107.430		
Edison Cost @ .03 per kw.	$3,222.90	
Our cost @ .009 per kw.	970.00	
Saving	$2,252.90	
Elec. Saving	$2,252.90	
Steam "	1,374.09	
Total "	$3,626.99	

It should be emphasized that the management does not consider that the economy of the plant is yet at its maximum by any means. It is planned to install such additional instruments as a CO_2 meter and steam flow meters. Additional experience must result in better economy.

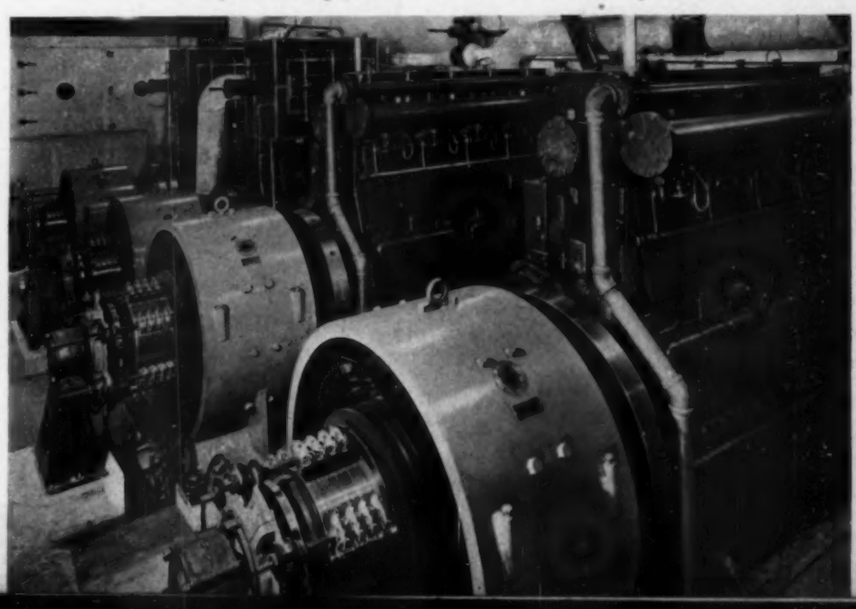
Light, power and heat – the familiar three. In these buildings, electricity is used for lights and power, and steam for heating. All power circuits are 250 volts, and all lighting circuits are 125 volts. The generators are 250-volt three wire dc. machines, rated at 600 amperes, with a 125-volt takeoff good for 150 amperes. Ordinarily the lighting load is fully balanced between the circuits; but during off periods such as during the night when the building is being cleaned, only a lighting circuit here and there is turned on. Then the 125-volt connection on the generators takes that load.

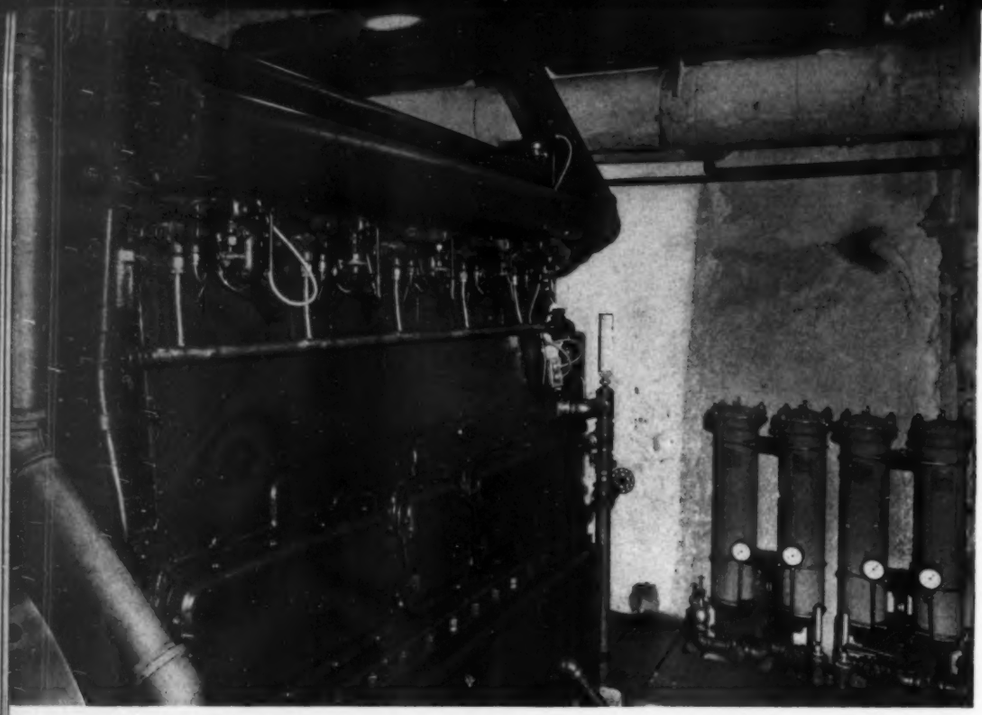
As shown on the layout of the engine room, there are four engine generating sets, two steam and two Diesel. The steam units are double acting Ames uniflow engines running at 450 rpm. and direct connected to 150 kw. Crocker-Wheeler generators. The Diesel units are five-cylinder four-cycle Ingersoll Rand Type S engines direct connected to 150 kw. Crocker-Wheeler generators. These engines are described in detail in another article in this issue.

All generators are of engine type, with S.K.F. outboard bearings on the Diesel units. Woodward governors of the adjustable speed type are fitted. These enable the operators to control the voltage generated and thus the load distribution between units both by varying the engine speed and by using the generator field rheostats. The latter method is the one used in every day service.

Steam is generated at about 185 lbs. pressure in two oil fired Keeler water tube boilers. Steam from the boilers flows first to a welded high pressure receiver and separator placed high up on the engine room wall above the engines. Any entrained water which may have come over from the boilers with the steam is separated out by baffles inside and drained back to the boilers. Another important function of this receiver is that it gives a supply of steam at boiler pressure right at the engines ready to respond to unusual demands, without appreciable drop in pressure, when the governor opens the steam valve suddenly to

General view of the four power units: Two I-R Diesels and two Ames steam engines driving four 150 kw. Crocker-Wheeler generators.





Above the two I-R Diesels are the Maxim intake mufflers and against the wall are four Nugent lubricating oil filters serving both engines.

meet large increases in the load due to elevator power fluctuations. From the receiver the steam flows to the engines. The exhaust from the engines is to a low pressure receiver located at the end of the engines below the floor. Steam from this receiver flows throughout the building heating mains. The drains returning from the heating mains go to the Worthington open feed water heater.

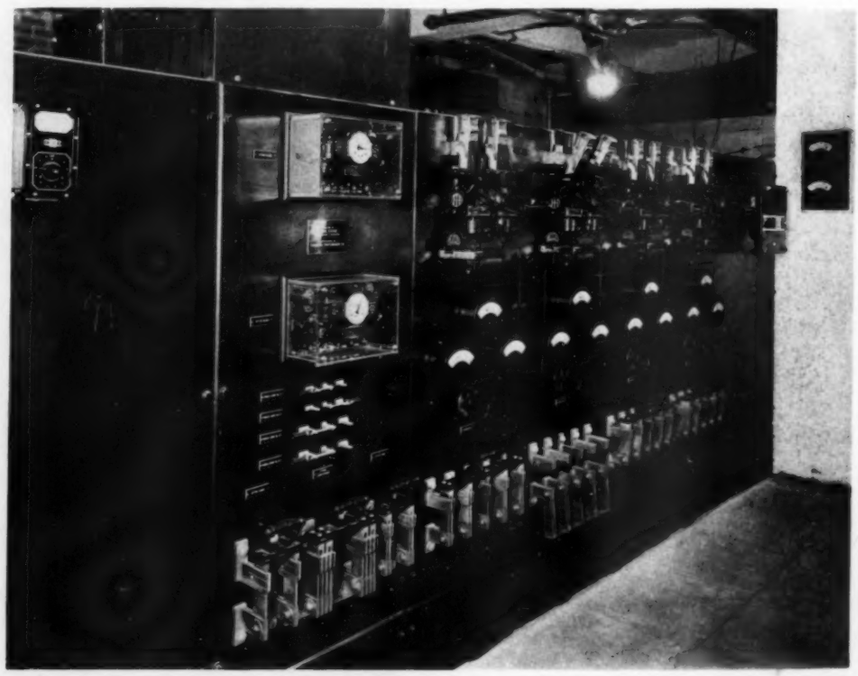
The operating procedure is to maintain a pressure of from one to three pounds of steam in the low pressure receiver. Normally, this steam is reduced from boiler to receiver pressure by running it through the steam engines and taking off what power there is available. In addition, for use when more steam is required than the engines need for carrying the power load, there is a special connection from the high pressure receiver to the low pressure receiver through a reducing valve. In case there is more load than the steam engines can carry for the heating requirements, then the surplus is carried on the Diesel engines. The net result is that in severe cold weather, there is enough steam for carrying all of the load on the steam engines; and in the summer time, all of the load will be carried on the Diesels. In intermediate weather, both Diesel and steam engines are operated and the load is divided between them according to the steam heating demands.

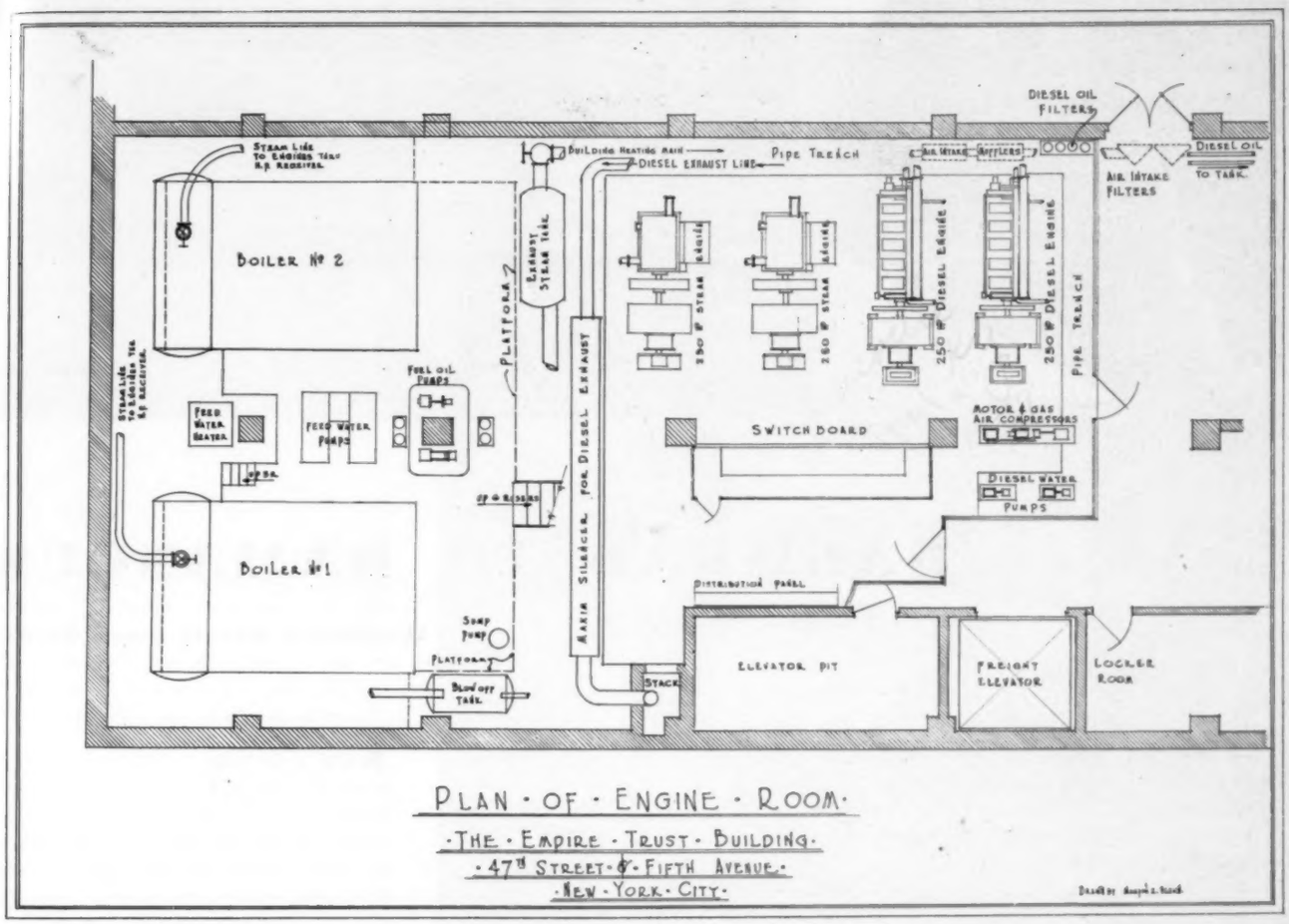
Besides flexibility of the plant there is the element of reliability, for there are no outside connections for breakdown service. All dependence is placed on the machinery in the plant for every requirement. This is conservative because there is duplicate equipment throughout for all needs, and there is a firm power capacity of 600 kw. for a maximum power load of perhaps 400 kw. This maximum load comes late in the afternoon in the winter time when all of the lights are on, and all of the elevators are running to carry the workers out of the building on their way home.

For serving the steam equipment there are two steam driven boiler feed pumps, and two fuel pressure pumps. One of the latter is steam driven and one is electric motor driven. The boiler feed pumps are under the automatic control of Copes regulators and pump governors. The exhaust steam from these steam pumps is returned to the open feed water heater, and if necessary steam from the low pressure steam receiver is also turned into the feed heater. The practice is to maintain the feed water temperature at 215 degrees F. Note the use of the motor driven boiler fuel pump for firing the boilers up from a cold condition, for there is always electric power available from the Diesel units.

The present engine and boiler room was formerly Brentano's shipping room. As shown in the sectional view on the drawing, the boiler room floor is about four feet below the floor around the engines. This was necessary to give sufficient head room for the boilers. The foundation problem was a simple one. When the floor was excavated for the foundations, it was found that under the boilers there was shale and hard blue clay, and under the engines there was rock. So for the engines, the ground was all leveled off at the proper depth, and a six-inch layer of sand put down.

Convenience and neatness mark the switchboard. The Brown pyrometer serving both Diesels appears at the extreme left.





PLAN · OF · ENGINE · ROOM ·

· THE · EMPIRE · TRUST · BUILDING ·

· 47th STREET · & · FIFTH AVENUE ·

· NEW · YORK · CITY ·

Then a concrete foundation block in one piece for both steam and Diesel engines was poured. The space around the block, between it and the trenches and floor construction, was also filled with sand. The engine foundation is thus completely isolated from the building by a layer of sand. Of vital importance is the total absence of vibration at any point.

Intake air for the Diesel engines is taken from the engine room through American cell type air filters. Each engine has its own intake system, and the air flows from the filters through a Maxim silencer to the header on the engine. The filters and the silencer are high upon the wall at the end of the engines, and the pipes from them lead overhead to the engine headers. The exhaust lines from the engines lead down under the floor into a common pipe which runs to the single Maxim silencer over 20 feet long and of special design. It is located under the grating at the boiler end of the room. Then the outlet is upward with the pipe at an angle of about 60 degrees from horizontal and into the chimney.

The exhaust piping and silencer are carefully lagged to eliminate radiation of heat to the engine room. The silencing of the intake and exhaust is complete enough so that no noise from these sources is noticeable in the engine room.

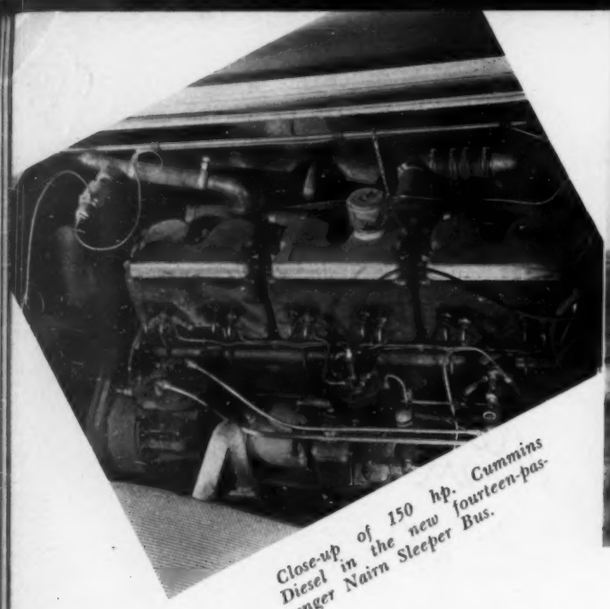
In order to prevent blowback of the exhaust gases into the engine which is idle, a special form of valve is used in each exhaust branch line. This valve consists of a plate which slides into a slot, and is held in place and is sealed against gas leakage into the engine room by a cover secured by wing nuts. When the engine is to be put into use, the valve plate is removed. A bellows section in the branch piping takes care of expansion in the piping due to heat.

The chimney arrangement for carrying away the exhaust gases is rather unique. The flue gases from the boiler and the exhaust from the engine are both turned into an existing chimney, in size a little over three feet square, and extending upward for 18 floors. A good big peep hole has been knocked through the brick wall above the end of the Diesel exhaust and just besow the outlet from the boiler flue. While there is an electric eye on the boiler flue for indicating any smoke in the flue gases, the peep hole is so illuminated as to show both the Diesel exhaust and the flue gases. Thus it is a simple matter for the engineer on duty to keep a constant check up on combustion in both boilers and Diesel engines. Under the circumstances with the volume of hot gases going up the chimney, there is a powerful draft to carry them away.

There is a Brown pyrometer for indicating the exhaust temperatures of the Diesel engines. There are ten connections, one for each cylinder.

For the fuel there is a 10,000-gallon tank located at the street end of the engine space. This tank was assembled and welded right in place. It is divided into two compartments, one for the boiler fuel of 7,000 gallons capac-

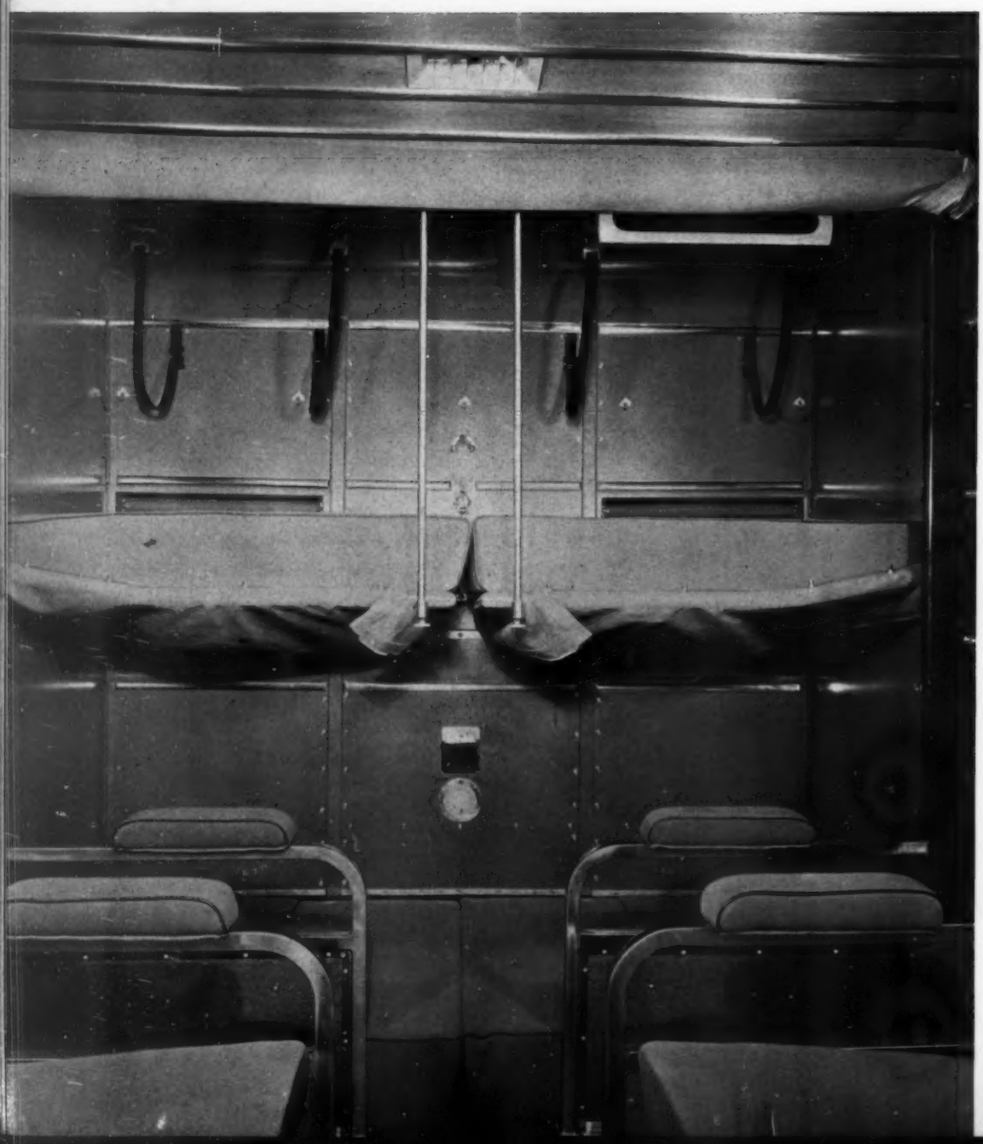
. . . . *And now please turn to page 38*



Close-up of 150 hp. Cummins Diesel in the new fourteen-passenger Nairn Sleeper Bus.

BAGHDAD TO DAMASCUS

New Sleeper Bus for Desert Travel



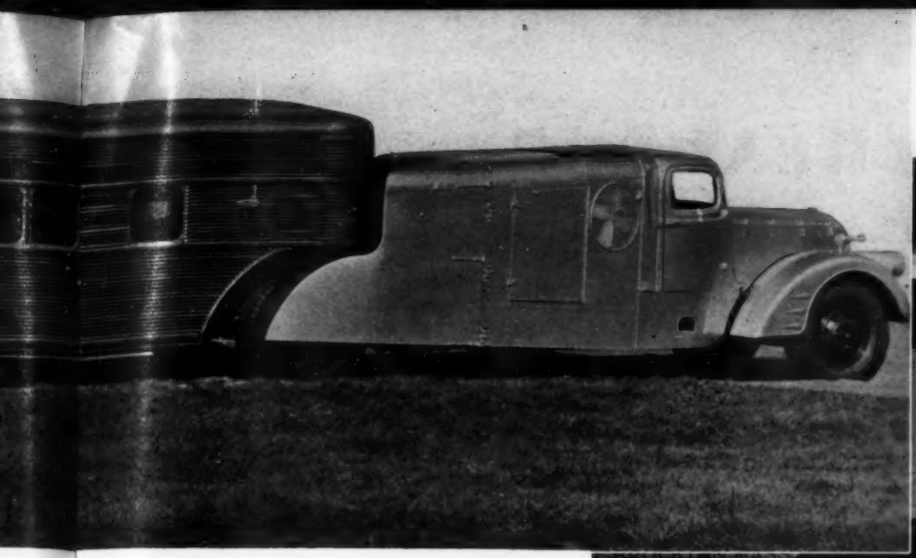
THIS huge light weight, stainless steel sleeper bus, designed to accomodate fourteen passengers, will traverse the Syrian Desert between Beyrouth, Damascus and Baghdad as the newest form of transportation to replace the camel.

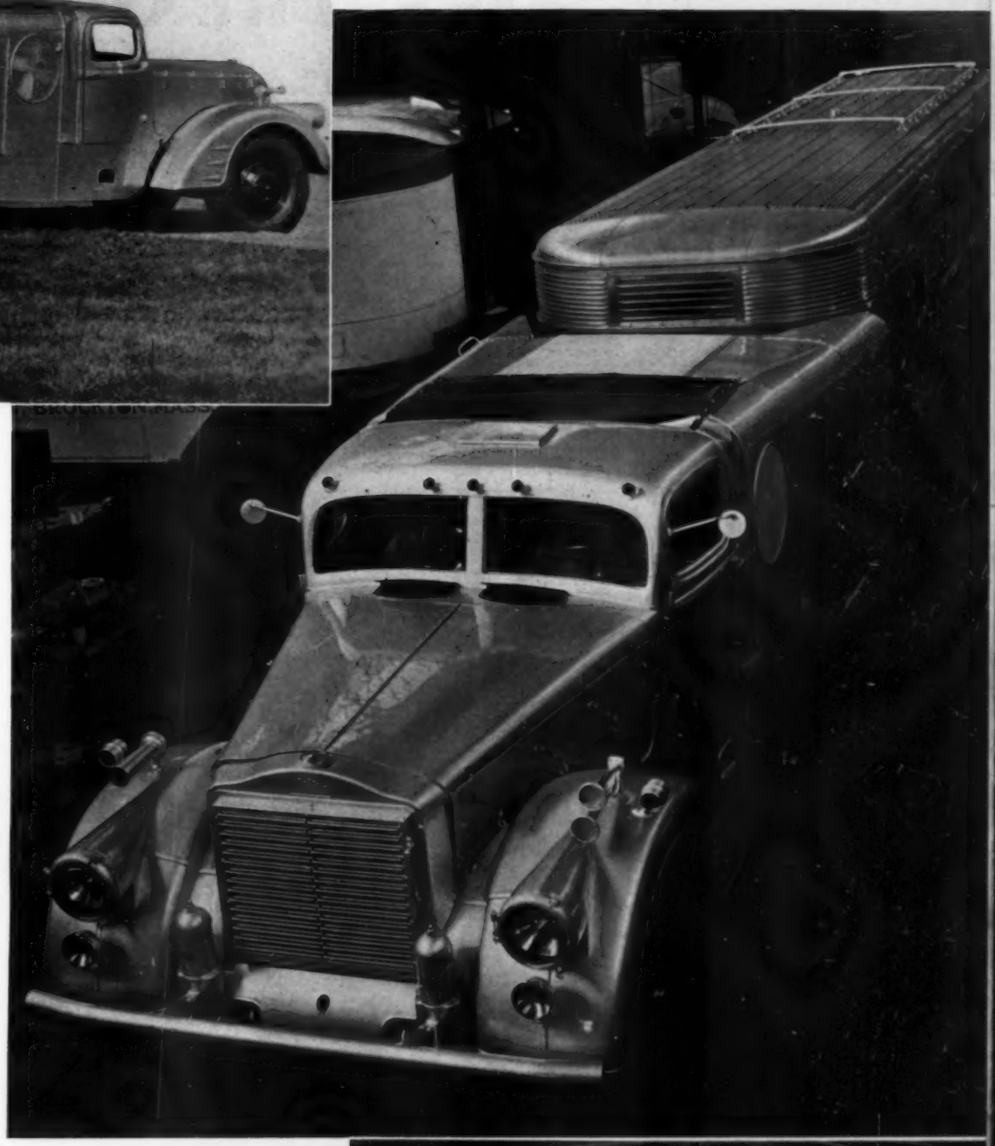
The Nairn Transport Company, Ltd., has been operating a line of buses between these cities for several years and successfully so. In 1934 they took delivery of a Marmon-Herrington-Hercules Diesel powered bus for this same service. Now they are back over here again for more American equipment. This time three big sleeper buses illustrated herewith and ten Cummins Diesel engines.

This newest piece of equipment was constructed by Edward G. Budd Mfg. Co. insofar as the trailer is concerned. The tractor is the result of the combined efforts of White Motor Truck, Van Dorn Iron Works and a 150 hp. Cummins Diesel.

The trailer is air conditioned and fully insulated against the intense desert heat. Although designed as a sleeper, it can be readily converted into a day coach. Berths are longer than in standard sleeping cars and every bit as comfortable. Two dressing rooms are provided equipped with running water.

Illustrating berth layout. In foreground berth made up for day travel, in background berths made up for sleeping.





The route traveled is just over 600 miles through desert with temperatures frequently hitting 140, yet air conditioning and insulation make this bus both comfortable and quiet. At a maximum speed of 65 mph. this new bus is planned to make the 600 mile trip in 15 hours instead of the current 24 hours. No service stops are made on the run. Meals are served to passengers by an attendant and food supplies for a week in the desert are carried.

Construction of this sleeper-trailer follows closely the design of the Diesel powered railroad equipment built by the E. G. Budd Company, as for instance the family of famous Burlington *Zephyrs*. The same light weight stainless steel was used and the same "Shotweld" system of manufacture was followed. The net result is a new contribution to the art of comfortable, fast road transportation.

The over-all length of the trailer and tractor is 57 feet, 6 inches and that of the trailer alone 36 feet, 8 inches. Over-all height when loaded is 8 feet, 7 inches. The bus weights 28,000 lbs. Baggage and supplies are carried in lockers located in the forward section.

Great credit is due the Nairn Transport Company for its pioneering spirit, for its originality in writing the specifications for a bus so totally different from anything ever previously built. They know their operating conditions and this bus is what they want. They came to America for it because we have over here a real knowledge of light-weight, strong construction as evidenced by the increasing fleet of streamline trains, etc. Then of course we have the Diesel engines which make such a bus as this practical to operate over long distances in territories where gasoline is both hard to obtain and high in first cost.

Dressing room and lavatory of the 14 passenger Diesel driven Sleeper Bus.

ICE BREAKERS

General Description of New Coast Guard Harbor Craft "AB-25" and "AB-26"

By WALTER J. McINNIS

THE contract for these boats was awarded to the George Lawley & Son Corporation, of Neponset, Massachusetts, in the fall of 1935, and they retained the firm of Eldredge-McInnis, Inc., Boston Massachusetts, as architects and engineers to develop the detailed plans and specifications which would suit the preliminary ideas as set forth by the United States Coast Guard.

Their principal dimensions are:

Length overall	63′ 6″
Length between perpendiculars	57′ 9″
Beam, moulded	19′ 0″
Depth, amidships	7′ 11″
Draft, maximum	4′ 11″

Displacement of about 70 tons.

The hull-form was developed with special consideration towards operating or breaking-ice in shallow water. It was also necessary to keep the cross-section form so that, at no point on the sides, would there be any danger of pinching, under severe ice conditions.

The construction is of wood throughout and, of course, very heavy to withstand the work required of them. They have double-sawed 3″ oak frames, spaced 18″ from the forebody, aft; and spaced 9″ in the forefoot. Keel, stem and longitudinal members are of oak and yellow pine; planking of 2¼″ yellow pine, sheathed with galvanized steel laid over felt on the entire underbody and to a point about 18″ above the waterline; deck beams of heavy yellow pine well reenforced with knees and other blocks so as to carry the deck, which is of Oregon fir, and the usual towing bitts, windlass, steering apparatus, etc. The superstructure is all of steel, with teak trimmings, built in the usual husky Coast Guard fashion.

These boats are arranged with crew's quarters, forward, for four men, commanding officer's stateroom and toilet.

Located amidships is the engineeroom and, aft of this point the galley, messroom and inspectors' quarters. There is a commodious pilothouse in which is located steering apparatus, navigating equipment, short-wave radio equipment, sofa, etc.

The power plant is an 8 cylinder, 8″ x 10″, 300 hp., solid injection Winton Diesel motor, direct-driving a 3½″ Monel metal shaft. Coupled with the main engine is a belt-driven compressor and provision is made for the following auxiliaries: Sun Doxford single cylinder, 8 hp., direct connected, 110-volt generating set; Sun Doxford single cylinder, 8 hp., direct connected air compressor, which supplies the four starting tanks. The engineroom also contains work bench; Fairbanks-Morse general service pump; radio batteries; Goulds lubricating oil purifier; oil filter tank; air compressor and tank for whistle; switchboard; C-O-Two fire extinguishing system; lubricating oil tanks; ventilating blowers; tool lockers; drawers; etc. There are also two Everdur fuel tanks, arranged port and starboard, to contain a total of 900 gallons of oil. Main engine and auxiliaries exhaust into mufflers in the stack through eclipse type flexible galvanized exhaust tubing. The whole engineroom is insulated overhead, and on the bulkheads, with 2″ cork. The boats are divided into four watertight compartments with steel bulkheads each of which is insulated with cork.

Walter J. McInnis of Eldredge-McInnis, Inc., Naval Architects, who designed these new Diesel ice breakers.

Their outboard appearance resembles very closely the profile of the modern, small Diesel tug, having single signal mast with monkey-gaff, towing lights, insulated radio antenna, etc. The stack is short and in keeping with the characteristics of the hull. The balance of deck equipment includes dory, deck chests, Gould deck pump, 18″ Sperry searchlight, horn, outside binnacle and usual davits, capstan and bitts.

AB-25 has been delivered to the Coast Guard and is at her station in Great South Bay, Long Island. *AB-26* was recently launched and will be delivered in the near future. Their equipment is complete with all such necessities as hospital appliances, towing hawsers, emergency signals, Coast Guard standard low-wave radio outfit, etc., in preparation for any emergency which might arise.

Their speed is 10.5 knots, which is considered remarkable in view of the type and form.

DIESEL ENGINES

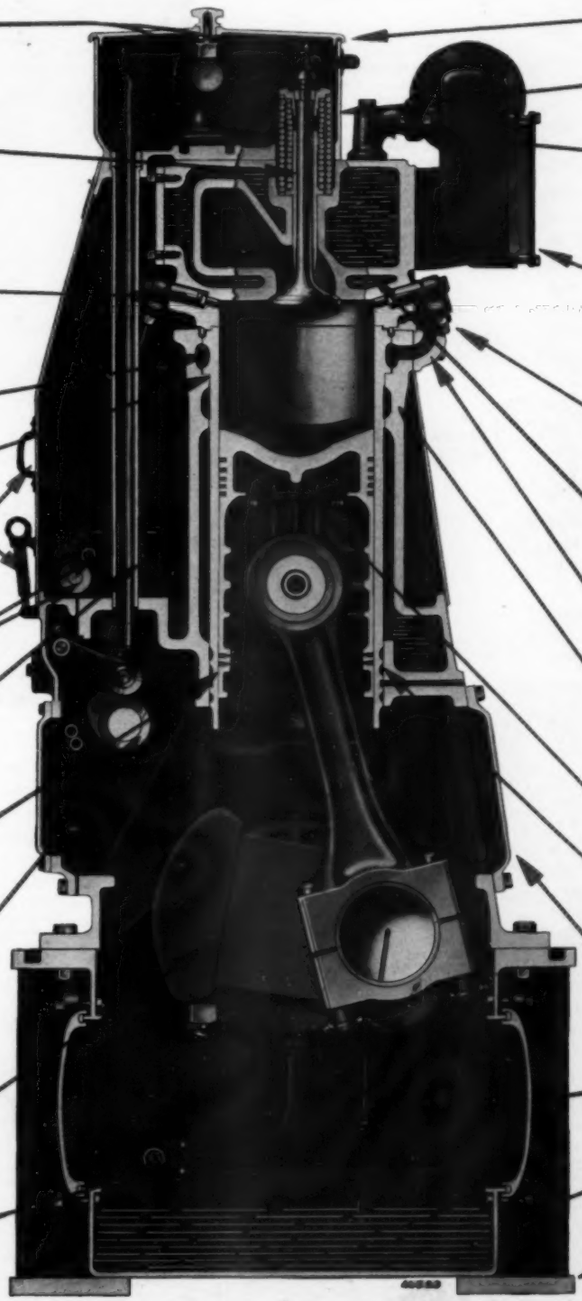
By JOHN W. ANDERSON

No. 1. INGERSOLL RAND TYPE "S"

MADE in three, four, five, six and eight cylinders, 10" bore by 12" stroke, for ratings from 150 to 460 hp. at 514 and 600 rpm., these four cycle engines are in the medium speed class designed for heavy duty continuous service. They are particularly adapted for direct connection to electric generators, and through power drives to any type of machinery. The illustrations show the details of the construction.

The heart of any Diesel engine is the combustion system. That used on this engine has one characteristic in common with the Price system so long associated with Ingersoll Rand engines, and that is the use of twin opposed spray nozzles. In order to do this, the top of the piston is dished to form the combustion chamber, and the air intake passages in the cylinder head are so shaped that they direct the incoming air in a rotary motion to provide a rotary turbulence. The proper intermingling of fuel and air is accomplished by directing the fuel sprays from the opposed nozzles through the swirling air, and at such an angle as to avoid impingement on the piston surfaces.

The spray nozzles themselves are of the single hole type, and there are two check valves in series back of the nozzle to shut off the in-



Automatically lubricated valve mechanism guarantees the exact amount of lubrication required.

Long guides prevent valve stem from binding. Exhaust valve guide counterbored to prevent sticking.

One of twin opposed spray nozzles. Removable by taking off two nuts.

High velocity cooling water space around top of liner.

Supporting shoulder for liner located well down so that extra metal will not interfere with heat transfer.

Easily removable covers.

Fuel pump control shaft and fuel oil manifold.

Valve push rods in oil tight guides so that dirt cannot work into or oil escape from crankcase.

Three rubber rings with water trap and tell tale connection. Impossible for cooling water to leak into crankcase and emulsify lubricating oil.

Cam shaft which operates fuel pumps and intake and exhaust valves, driven from flywheel end, reducing irregularity.

Counterweights on cranks reduce load on main bearings.

Lubricating oil header with connection to main bearing.

Individual valve covers.

Double springs on valves reduce maximum stresses.

Water discharge manifold connections from cylinder heads taken at highest point thus preventing formation of trapped steam pockets.

Open, inlet air manifold with panel type filter running full length of engine. Closed manifold can be supplied with connection taken from either end to air intake pipe.

Fuel pipe connection—easily detachable.

Bridge in cylinder head which forces water to cross to opposite side thus preventing short circuiting. High velocity around valve seats improves heat transfer.

Water jumper around joint between cylinder and head.

Lower high velocity cooling water space.

Strongly ribbed piston—cast iron.

Two vented lubricating oil control scraper rings.

Large, working doors.

Welded steel sub-base with large oil reservoir.

Large foundation bearing flanges. Flat underside permits using inexpensive foundation and simplifies erection.

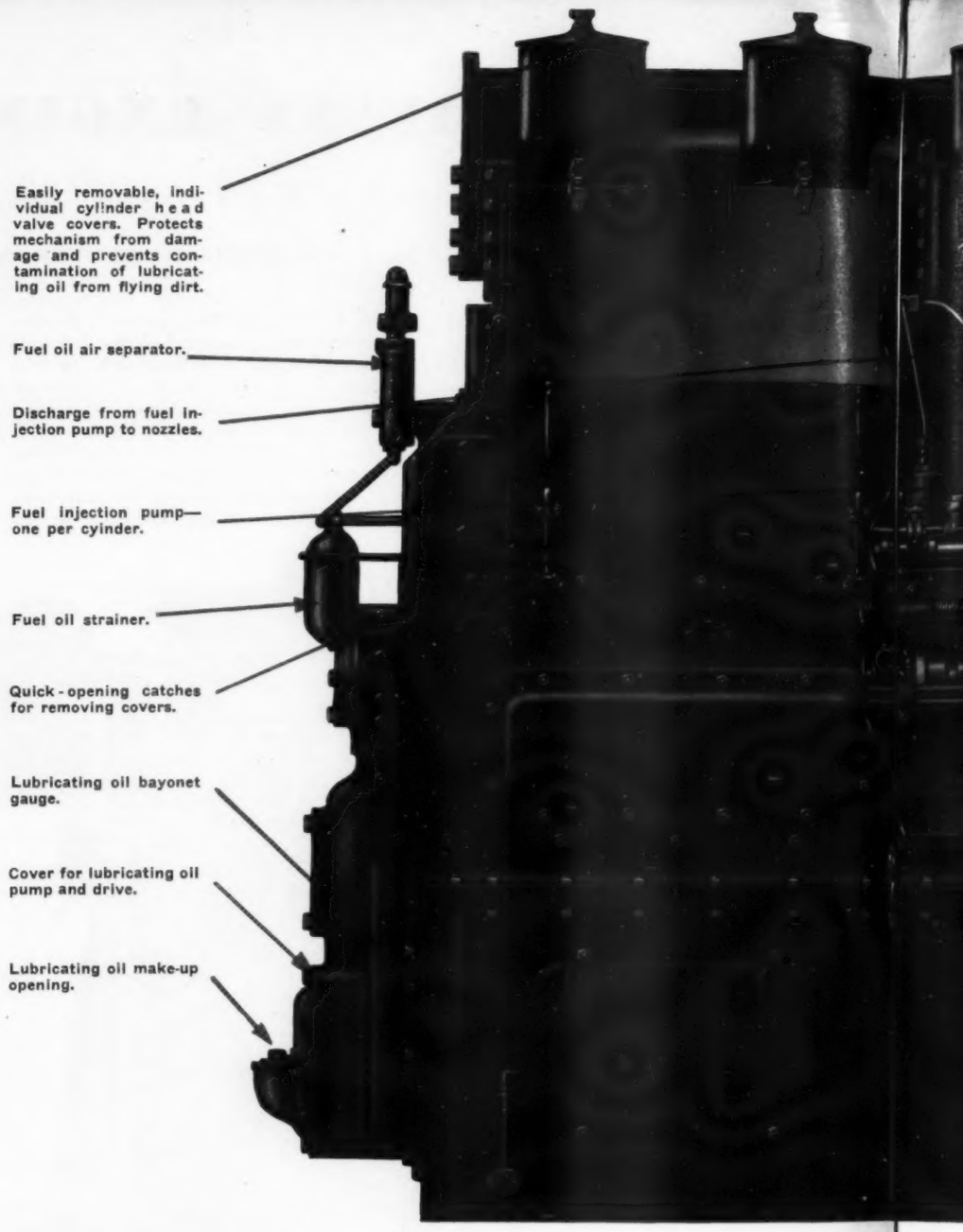
jection positively, and to prevent dribbling of the fuel into the combustion chamber or leakage of the gases back into the fuel piping. There is one Bosch injection pump for each cylinder and it is placed opposite the cylinder at the side of the engine just above, and driven from, the camshaft. This keeps the connecting pipes between the pump and the nozzles short, and of the same length for every cylinder. The quantity of fuel injected is regulated according to the load by a common control shaft actuated by the governor. This pump control is distinctive in that it is so designed that in case any single pump sticks, it is automatically cut out and the other pumps operate naturally, thus maintaining speed control of the engine.

The illustrations show how all of these injection pumps are arranged in a separate compartment on the side of the engine, that is enclosed by light sheet metal covers which are easily and quickly removed for inspection of the injection system, yet they add to the smooth exterior appearance of the engine when they are in place. Note that this arrangement provides complete separation of the fuel system so that any fuel leakage cannot get into the lubricating oil.

Fuel is pumped from the storage tanks and supplied to the injection pumps under a slight pressure by the rotary supply pump at the operating end of the engine. This pump is driven from the end of the camshaft, and delivers through an air separator and through filters in series to the header for the injection pumps. Of course the supply pump must provide at all times more fuel than the injection pumps can possibly use. This surplus is cared for by a relief valve on the top of the air separator chamber which delivers the surplus fuel back to the storage tanks. Since this relief valve is on the top of the chamber, it also gets rid of any air which may have come along with the fuel, and thus only solid fuel can flow out of the bottom of the chamber to the injection pump supply header. This ensures regular and reliable operation of the injection pumps.

The overall results of the combustion system are measured by the fuel consumption curve as shown on page 31. This gives the fuel consumption in pounds of fuel per horsepower hour at rated speed, and shows that there is little variation in economy in the region of three-quarter load to full load. Expressed in another way, these engines, when operating in this load region, will produce about 19 brake horsepower hours or over 13 kilowatt hours per gallon of fuel.

The lubricating oil system is shown in the illustration. The gear type pump driven from the crankshaft takes its suction through a strainer from the sump in the base, and delivers through oil filters placed outside of the engine. The clean oil returns to the headers in the engine, which supply all of the bearings and the various parts which require lubrication. All parts of the engine which need oiling are cared for by the one system.


Easily removable, individual cylinder head valve covers. Protects mechanism from damage and prevents contamination of lubricating oil from flying dirt.
Fuel oil air separator.
Discharge from fuel injection pump to nozzles.
Fuel injection pump—one per cylinder.
Fuel oil strainer.
Quick-opening catches for removing covers.
Lubricating oil bayonet gauge.
Cover for lubricating oil pump and drive.
Lubricating oil make-up opening.

This requires different pressures for the various purposes, and relief valves in the headers are fitted to maintain the proper pressure in each case. The surplus oil drains back to the sump in the base and is recirculated. There is a bayonet type oil gauge on the front of the engine near the operating end for determining the oil level in the sump. Note the two oil scraper rings at the bottom of the piston skirt and vented grooves.

This system is entirely automatic, starts and stops with the engine, and requires no attention from the operator except to see that the filters are kept clean and to add makeup oil. The system is entirely self contained in the engine except for the filters.

The cooling water system is especially designed to provide a high velocity of flow where the engine parts are the hottest and thus where the greatest cooling effect is needed. The illustration shows the path of the cooling water through the engine. It enters through a header casting on the back of the housing, whence it flows upward through the individual jacket spaces. In order to avoid a concentration of metal at the top of the cylinder liner, the supporting shoulder is moved down from the top. Then a circumferential rib in the housing, several inches below this shoulder, forms with the shoulder a high velocity cooling space. Above the supporting shoulder there is another high velocity cooling space, and this is sealed water tight at the top by a special rubber gasket, pressed tightly in place by a steel ring on top of it. This steel ring

Water tightness of joint effected by steel ring bearing on rubber gasket.
Fuel oil header.
Fuel pump control shaft mounted on ball bearings, operated by governor.
Oil-tight partition prevents lubricating oil splashing on inside of piston head and forming carbon.
Full floating wrist pin. No clamping in piston or piston bosses, which may cause distortion. Complete sealing of oil from piston pin bearing to cylinder walls is effected.
Force-feed lubrication to bearing in piston bosses.
Vents from oil scraper ring grooves.
Oil throwers prevent oil working out and damaging generator.
Half of solid coupling with centering disc.
Use of helical gears results in more quiet and efficient operation.

is in turn held by the cylinder head. The water joint at the lower end of the liner is made tight by three rubber rings in grooves. Between the lower rings there is a trap and a tell-tale drain to carry off outside of the engine any leakage, and thus prevent it from getting into the lubricating oil in the crankcase.

The flow of the water is then upward through the jacket space, through the two high velocity cooling water spaces in series, through an outside jumper connection to the cylinder head. Again, the cylinder heads are fitted with a special bridge in the jacket space, which forces the incoming water to flow across the head, around the valve seats in order to thoroughly cool them, to the opposite side of the head. The water overflows out of the top of the heads into a header located on top of the air intake manifold.

A generous supply of water to the engine keeps the overall temperature rise to a low figure. It gives a good distribution of flow among the cylinders, it gives high velocity cooling and eliminates hot spots, and the net result is to keep the entire engine at pretty much the same temperature. The source of the cooling water may vary with the individual installation, but usually main and standby motor driven centrifugal type pumps are installed.

Many mechanical details of the design help to make the engine a compact and self contained unit. There is the air intake manifold bolted to the side of the cylinder heads on the back of the engine, and panel type air filters are a part of this manifold. However, in case it is desirable in some individual installation to take the air from the outside, another type of manifold can be fitted with connections for piping at either end. There is no exhaust header as such. Instead, the

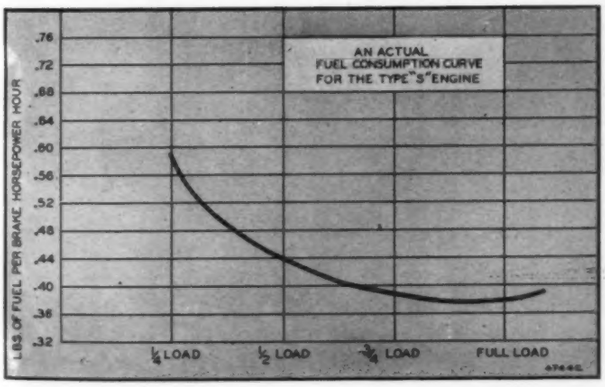
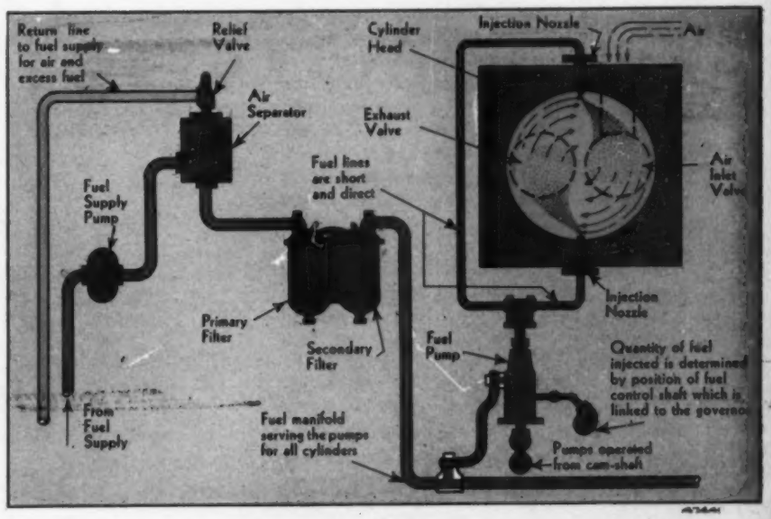


Diagram of fuel system. Note precautions taken to secure clean fuel and to assure accurate timing of the injection. Arrows show normal path of air.


Return line to fuel supply for air and excess fuel
Relief Valve
Cylinder Head
Injection Nozzle
Air
Air Separator
Exhaust Valve
Fuel lines are short and direct
Air Inlet Valve
Fuel Supply Pump
Injection Nozzle
Primary Filter
Secondary Filter
Fuel Pump
Quantity of fuel injected is determined by position of fuel control shaft which is linked to the governor
From Fuel Supply
Fuel manifold serving the pumps for all cylinders
Pumps operated from cam-shaft

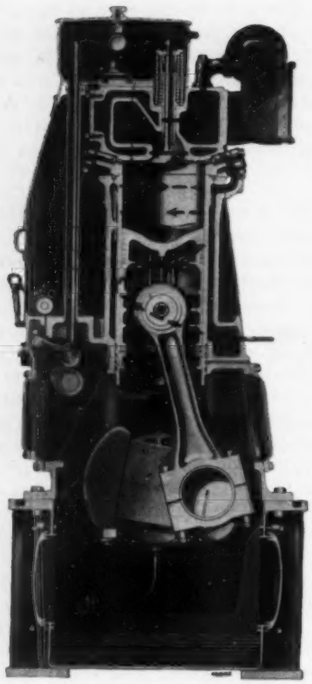


Diagram of the cooling system.

cylinder heads are bolted together, end to end, and a passageway through them carries off the exhaust gases. The exhaust pipe can be attached to either end of the engine as may be most convenient.

The overall height of any engine is a function of its stroke, and this engine with its stroke of 12" keeps the top of it within reach of the floor. Consequently no ladders or platforms are necessary.

This cylinder size also makes it feasible to carry the crankshaft underslung, with the main bearings secured to the under side of the housing as in usual automotive practice. This brings most of the main bearing wear on the caps and it is a little simpler to take up for wear and maintain the correct alignment of the main bearings. But in order to reduce bearing loads and wear to a minimum, counterweights are fitted to every web. At the same time, these help to reduce the unbalanced forces and thus improve the general balance and smooth running qualities of the engine.

There is a single camshaft for actuating the inlet and exhaust valves through push rods and rocker arms, and for driving the fuel injection pumps. The location of this camshaft in the crankcase space simplifies the lubrication of its mechanism and enables the use of a simple drive for it. This drive is at the flywheel end of the engine to reduce any irregulariies to a minimum, and consists of a train of three gears. The gear teeth are of the helical type for quietness, and the intermediate gear of the three, the idler gear, is carried in a special bracket held in place by four bolts. After the gears have been adjusted for proper tooth clearance, two dowel pins are added to eliminate any possibility of slipping.

Advantage is taken of this drive for the governor also. It is located on the flywheel end of the housing, which also makes for a convenient connection to the injection pump control shaft.

Close attention has been given to the details of enclosure of the engine. This makes it easier to amply lubricate all parts, it keeps the oil in and the dirt out, and it helps the appearance. Note how the valve gear parts at the top of the engine have spearate enclosures for each cylinder, and how the push rods are enclosed in individual tubes which extend from the crankcase to the enclosed spaces at the top. Yet with all of this there is no sacrifice of accessibility from the viewpoint of the operator and the maintenance man. There are many large covers which when removed give full access to all interior parts.

But that is not all. The cast iron base has a flat underside with wide foundation bearing flanges for easy handling in shipment of the engine and simple mounting directly on top of the engine foundation. Main and crankpin bearings have separate and interchangeable (for each bearing) upper and lower shells lined with babbitt centrifugally cast into the tinned shells. All of these bearings have shims for adjustment for wear. The cast iron piston is carefully designed to retain its true shape under all operating conditions, and it carries the full floating type wrist pin with bearing bushings in the connecting rod eye. The end of the crankshaft is a half coupling with centering disc, which makes it a simple matter to bolt on the proper size of flywheel needed for any given installation plus a suitable stub shaft for the power drive.

All of the operating controls are concentrated at the operating end of the engine which is the end opposite the flywheel. Here is the cock which controls the main starting air supply. There is a starting valve on every cylinder which is actuated and timed pneumatically from a distributor valve driven from the camshaft. Turning the main starting air cock puts all of the starting mechanism into or out of action. Here is the overspeed emergency stop which acts directly on the hand fuel control. And here are the two gauges showing the lubricating oil and cooling water pressures.

This engine is an interesting example of the trend of Diesel engine development because it is the outgrowth of extensive experience with locomotive engines of similar cylinder size.

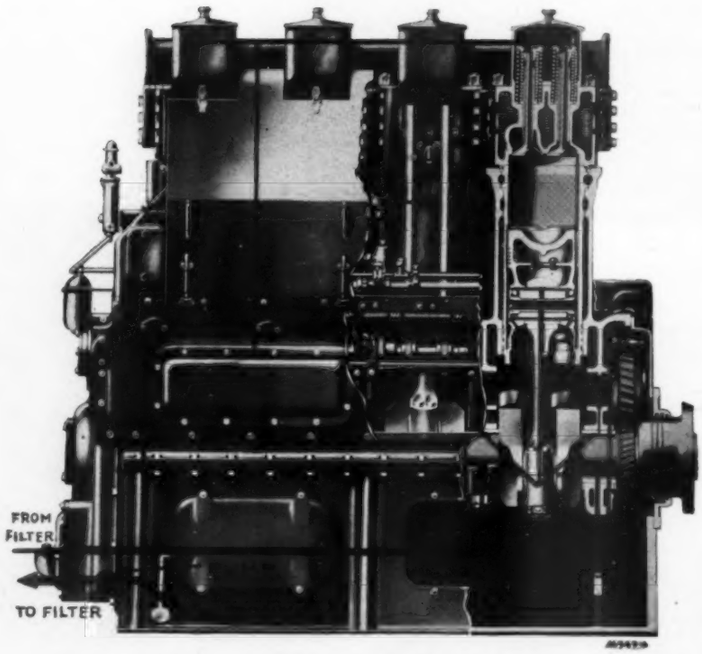
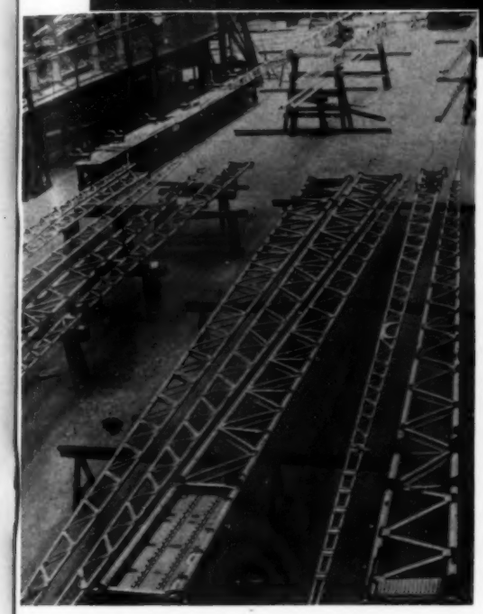
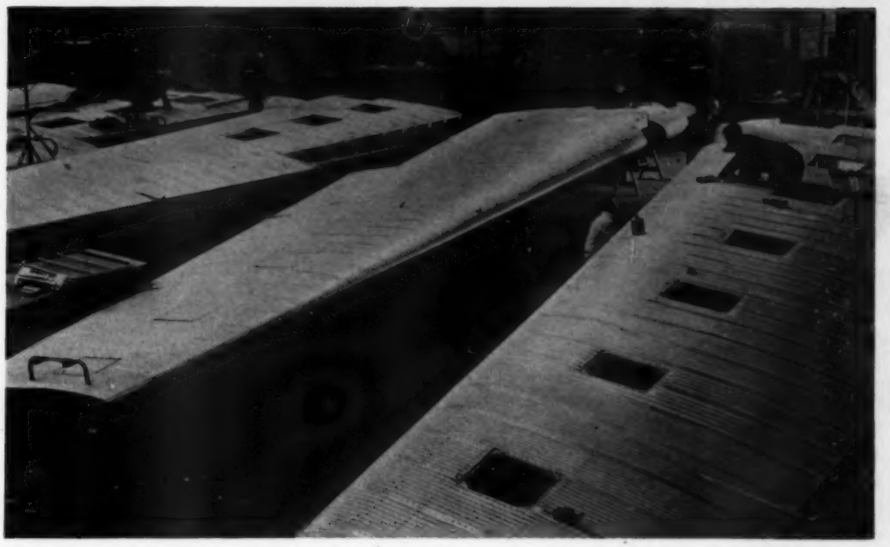


Diagram of the force feed lubrication system.





How a Junkers Ju 52/3m tri-motored airplane is constructed:
Left — Latticework wing beams of duralumin tubing riveted together. Although light in weight, they are tremendously strong. The size of the wing beams can be seen from the work bench. A wing frame is being assembled in the jig.
Right — Putting the finishing touches to the metal-covered wings. The oblong holes are for inspection purposes and will be covered with inspection doors. In the background two fuselages are nearing completion.
Above — The finished product, equipped with three Junkers "Jumo" 205-C Diesel engines. This plane belongs to Deutsche Lufthansa, the well-known German airline. Photo, courtesy of German Railroads Information office, New York.

SAFETY IN AVIATION

By PAUL H. WILKINSON

THE recent accidents to commercial aircraft in the United States, in which thirty-two people lost their lives within thirty days, is causing a great deal of excitement at Washington. But what will come of it? As in the past, evasive answers will be given by the so-called experts, and promises of closer supervision in the future will be offered as the solution to the problem. Perhaps there will be a recommendation for an appropriation of, say, $14,000,000 for additional safeguards, such as more powerful radio equipment and better weather reporting facilities. But will any allocation be made for means whereby an end may be put to the fires which so often break out before or after these crashes due to the highly inflammable fuel used? It is doubtful whether this matter will even be mentioned.

Commercial aviation claims that many more miles were flown in 1936 than in previous years, with fewer accidents per million miles flown. This is an old story and certainly does not prove that aviation is any safer. How can it be safer, when no intelligent effort is made to investigate and eliminate the cause of this appalling loss of life due to highly inflammable gasoline in many instances?

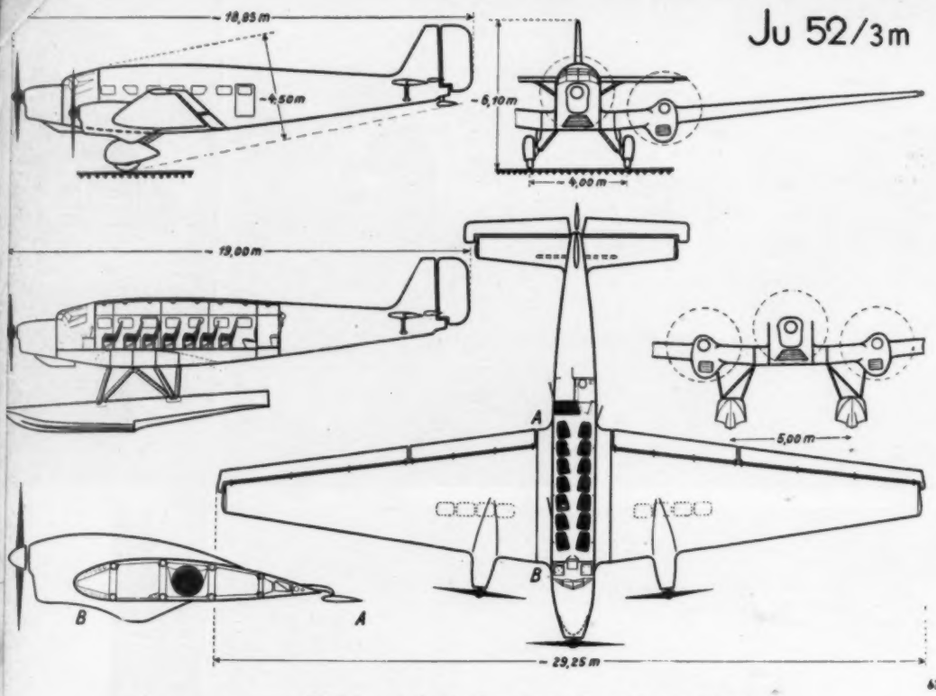


Diagram of the Junkers Ju 52/3m tri-motored landplane and seaplane powered with three Diesel engines. Its wing span is 95 ft. and its gross weight is 22,000 lbs. At a cruising speed of 175 mph., the landplane version has a flight range of 1,000 miles.

One recalls the crash and fire near Pittsburgh, Pa., on April 7, in which twelve lives were lost; the fire in the air near Dallas, Texas, on June 12 in which the co-pilot lost his life; the crash and fire at Pittsburgh, Pa., on September 6 in which ten people were burned to death; the crash and fire on September 29 near Naperville, Ill., when four people were burned to death; the crash and fire near Syracuse, New York, on November 15 in which three people were burned to death; and the crash and fire at Dallas on December 23 when six people were burned to death.

The accident to a commercial plane near Los Angeles on January 12 of this year is a striking example of the danger attending every flight made by aircraft in the United States today. On this occasion, fire did not break out, but the accounts of the accident only prove how disastrous it would have been to the semi-conscious occupants entrapped in the cabin of the plane. One passenger was killed at the scene, four died later, and most of the others were either in a badly injured or semi-conscious condition which made their escape from the wreckage practically impossible.

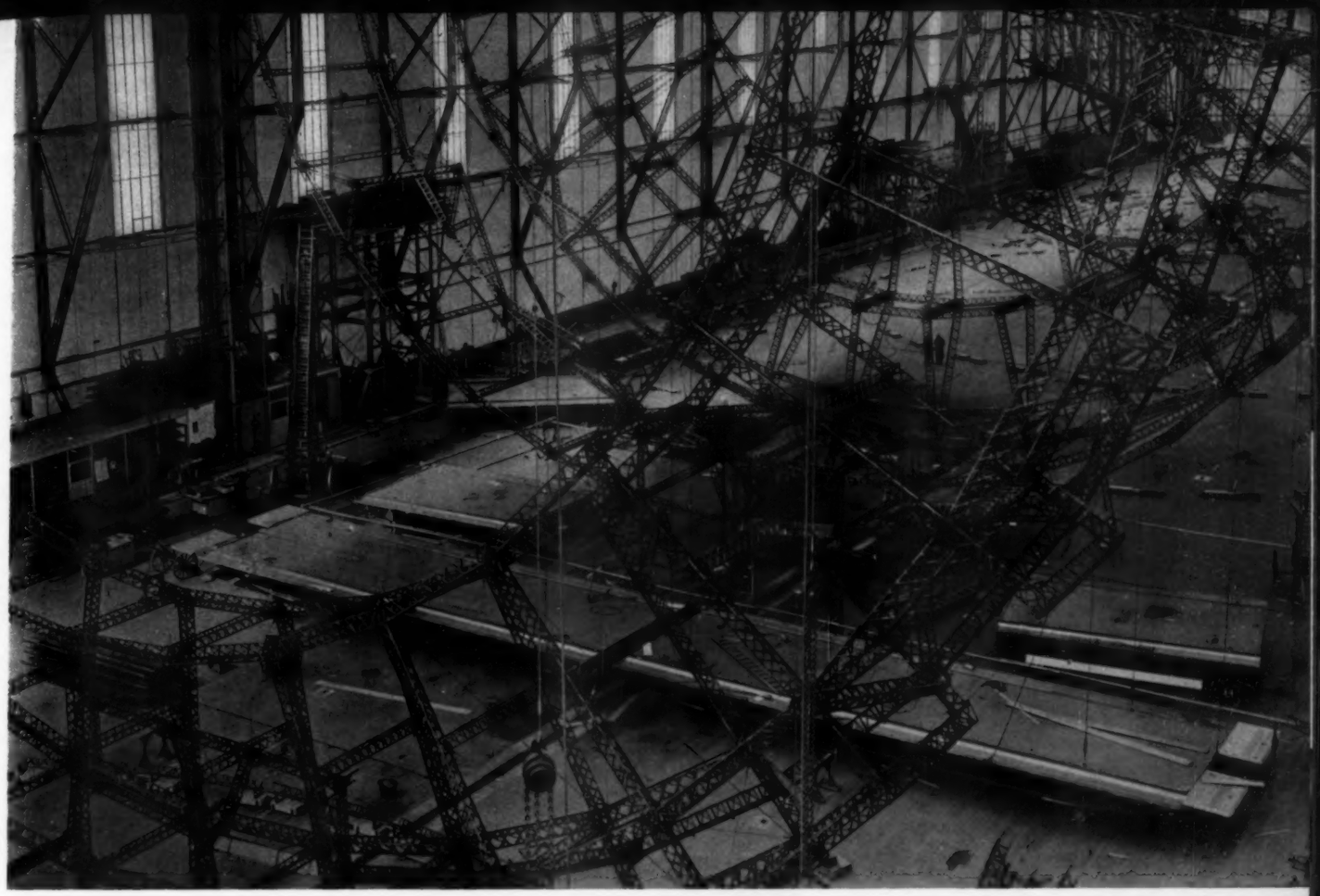
The pilot did what he could. He turned off the ignition switch which helped to avert a fire. It would seem, however, that since the plane was near the end of its journey, its gasoline tanks were nearly empty and as it landed uphill, the residue of the gasoline in the tanks was drained away from the hot engines. Good luck more than good management contributed to the escape of the survivors.

Strange as it may seem, military aviation is most reluctant for the public to know how many of its fliers and expensive planes are lost. Many of the men trained and the planes built at the taxpayer's expense, have been destroyed in fiery crashes. Although such matters are regarded as a military secret, the news sometimes leaks out into the newspapers. On some occasions roughhouse methods were used to obtain and destroy the photographs taken of these crashes – presumably in the interests of our National Defense. The wartime "flaming coffins" of 1918, however, were still with us in 1936!

Among the worst military crashes in 1936 were the disaster near Fredericksburg, Pa., on April 5 when five men were burned to death; the crash and fire at Norfolk, Va., on June 17 in which two men were burned to death; the fire in the air near New Kent Courthouse, Va., on August 13 when three men were burned to death; the fire in the air near Allegan, Mich., on August 18 in which two men were burned to death; the crash and fire at Middletown, Pa., on September 4 in which three men were burned to death; the crash and fire near Rhode Island State Airport on September 22 in which three men were burned to death; the crash near Bryans Mill, Texas, on October 25 in which two men were burned to death; and the crash and fire at Cincinnati, Ohio, on November 22 when two men lost their lives.

Such is the sickening repetition of our so-called progress. There have been many other fiery

A flying box car. View of the spacious interior of a Junkers Ju 52/3m freight carrier. Large pieces of machinery can be lowered through the hatch in the roof.

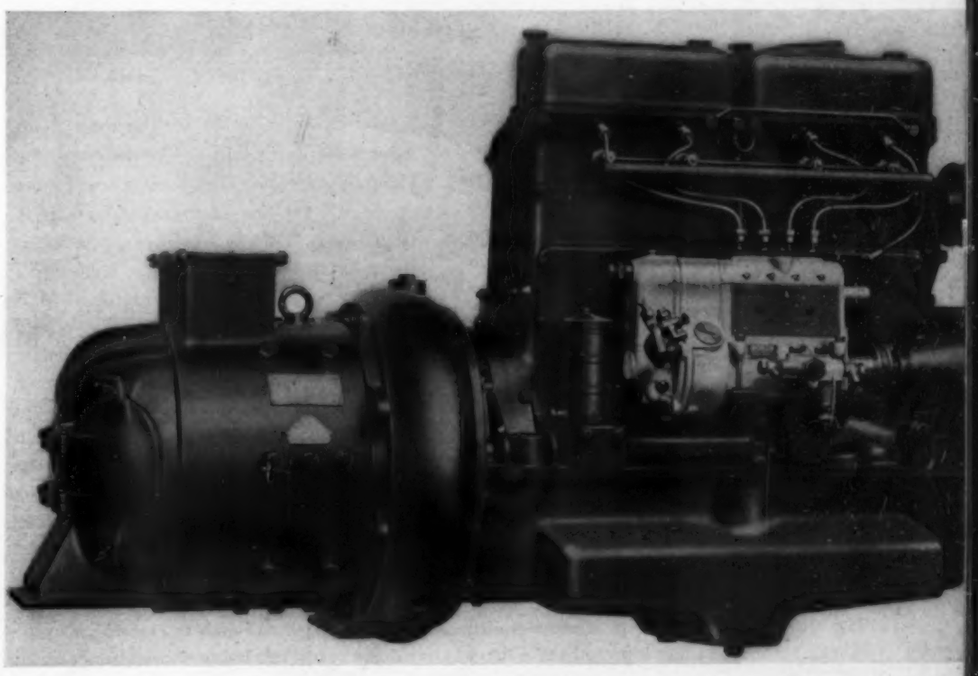


Framework of the new Zeppelin LZ-130 which is under construction at Friedrichshafen. The rings of the framework are assembled on the floor and are then hoisted into position. Notice the size of the men in the center of the picture.

crashes involving commercial, private and military planes, in which irreplaceable lives have been lost. There have been many narrow escapes. People have been burned to death, valuable planes have been destroyed, damage has been done to people and property on the ground, and mail has been reduced to ashes. Yet no investigation has been held to determine what can be done to put an end to this holocaust. Such is the record for 1936 — and it certainly cannot be called progress in the United States!

The solution to the problem is the Diesel. La Rue Appelgate, in his article in *The Annalist* of December 11, 1936, entitled "Recent Mechanical Improvements open wide field for Diesel-Powered Motors," writes: "The actual flights (of the *Aeolus* and the *Zephyr*) were not particularly startling, but what did make news was the fact that the 'flying yachts' used a *non-inflammable fuel.* Outwardly, this would seem to be a definite milestone in aviation." With articles appearing in other newspapers and technical journals belittling the Diesel and blindly extolling the virtues of the gasoline engine, we may well ask: "*Who* is holding back the Diesel for aviation?"

Below — One of the Diesel-electric generator sets which furnish the electricity for lighting, cooking and heating on the airship "Hindenburg." The 65 hp. 4-cylinder Mercedes-Benz OM-65 engine is coupled to a 33 kw. Siemens-Halske D.C. generator.



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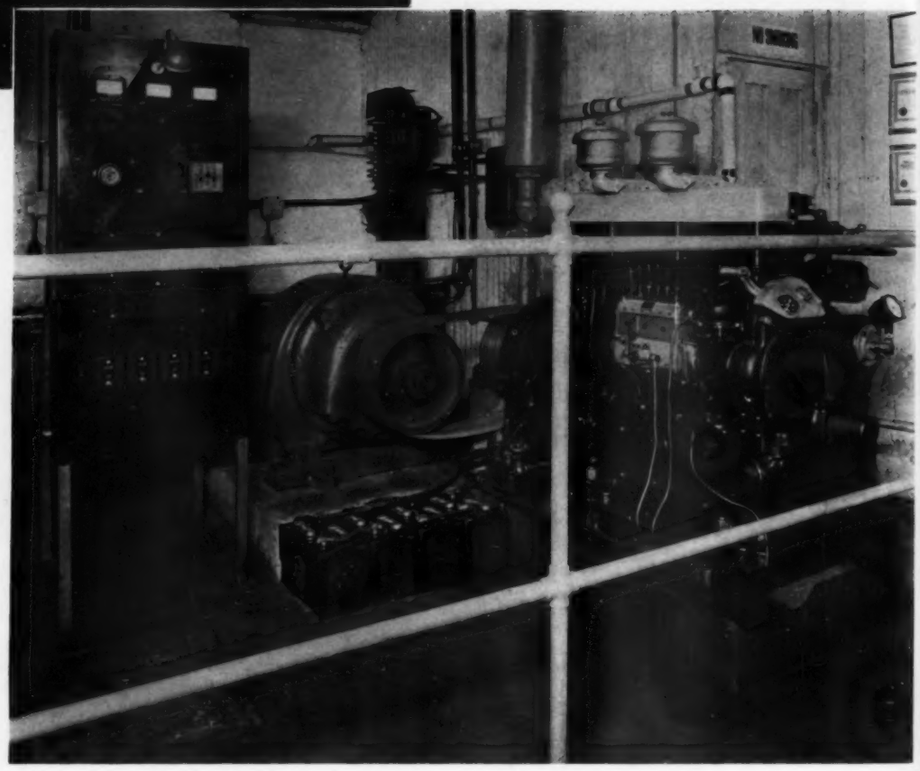


The Superior Diesel which now provides such impressive savings in power costs.

THE American Laundry Company's Diesel Engine installation in their plant at Trenton, New Jersey, is an outstanding example of the unusual savings possibilities of the Diesel Engine when full advantage is taken of the power produced and the recovery of exhaust and water jacket heat.

Previous to the installation of the Diesel Plant, the American Laundry bought electric power from the Utility Company and heated their water with oil fired boilers. The combined cost of power and oil for heating purposes represented a large item of expense which Mr. Levine, owner of the American Laundry Company, decided to reduce to the minimum by installing a Diesel Engine.

A survey of the lighting and power load indicated that a 40 kw. generator would be required, principally due to the fact that a 7½ hp. motor on an extractor drew approximately six times its normal running current for a short period when starting. This motor was used only intermittently, which indicated that the Diesel engine would operate at only about one-half load when the extractor motor was not in use and consequently the fuel consumption would not be as low per unit of power produced as if a higher load factor was maintained.

The water heating problem proved to be the answer to this question. Three 5 kw. heating coils were installed in the hot water tank and connected to the switchboard through a relay so that when the extractor motor was not in use the heating coils would keep the engine and generator loaded. As soon as the extractor motor is started the relay automatically cuts out the heating coils.

The engine is provided with a water cooled exhaust manifold so that a part of the exhaust heat is recovered in the cooling water. Soft water is led to the inlet side of the circulating pump on the engine at an average temperature of 65° F. The flow of cooling water is regulated automatically by a thermostatic valve on the inlet side so that an outlet temperature from the water jacketed exhaust manifold is maintained at 145° F. The water is carried direct to the tank and is not recirculated to the engine. This system is practically 100 per cent efficient in recovering the water jacket heat and about 10 to 15 per cent efficient in recovering the heat from the exhaust. The engine is provided with an oil cooler through which the jacket water is circulated, therefore, the heat losses on this installation are confined to a small percentage due to radiation and a relatively large percentage of exhaust heat. It is planned later to install an economizer in the exhaust and if this is done it is estimated about 80 per cent of the heat value of the fuel will be used. This compares with 30 to 35 per cent efficiency on installations where water jacket and exhaust heat is wasted.

During an eight weeks period of operation ending January 4, 1937, accurate records of current produced, water heated, average temperature rise in cooling water, fuel and lubricating oil consumption and operating costs were recorded as follows:

Current produced	13,980 kwh.
Fuel consumed	1,686 Gal.
Fuel cost	$89.67
Lube oil consumed	15 Gal.
Lube oil cost	$7.52
Water heated	17,814 cu. ft.
Av. water inlet temp.	65° F.
Av. water outlet temp.	145° F.
Av. water temp. rise	80° F.

AN LAUNDRY COMPANY

Candid camera shots illustrate how the Diesel generated power is used. The Diesel installation at the American Laundry consists of a Superior IA-6, 4½" bore, 5¾" stroke, 6 cylinders, rated 62 hp. at 1200 rpm.— Manufactured by the National Supply Company of Delaware, Superior Engine Division, Philadelphia, Pa.

Attention is called to the fact that the 17,814 cu. ft. of water heated during the eight weeks period refers only to the water that passed through the engine and does not include the water heated from the coils in the tank. These coils function both as a means of boosting the temperature of the engine jacket water and heating additional cold water supplied to the tank. Records were not made of the water heated by the coils in the tank, but, of course, the cost of operating the coils will be included in the cost of producing the electric current as the coils are wired through the recording meters on the switchboard.

The operating records given above show the following:

Fuel cost per kwh. of Electric Current ..... $89.67 / 13,980 = $00.00642

Lubricating oil cost per kwh. ..... $7.52 / 13,980 = $00.00054

Total cost per kwh. — Fuel and Lube Oil $00.00696
(or slightly less than 7/10c)

Cost of heating water ..... Nothing

Now in order to present a clearer picture of the savings that are being provided by this plant, we can, with the information available credit against the cost of producing electric current the previous cost for heating 17,814 cu. ft. of water from 65° F. to 145° F.

Water heated — 17,814 cu. ft.
Weight of 1 cu. ft. of water — 62.4 pounds
Average temperature rise — 80° F.
Cost of fuel per gallon — 5.25c
Heat value of fuel (per lb.) — 19,500 Btu.
Weight of fuel per gallon — 7.45 lbs.
Efficiency of water heater — 60 per cent

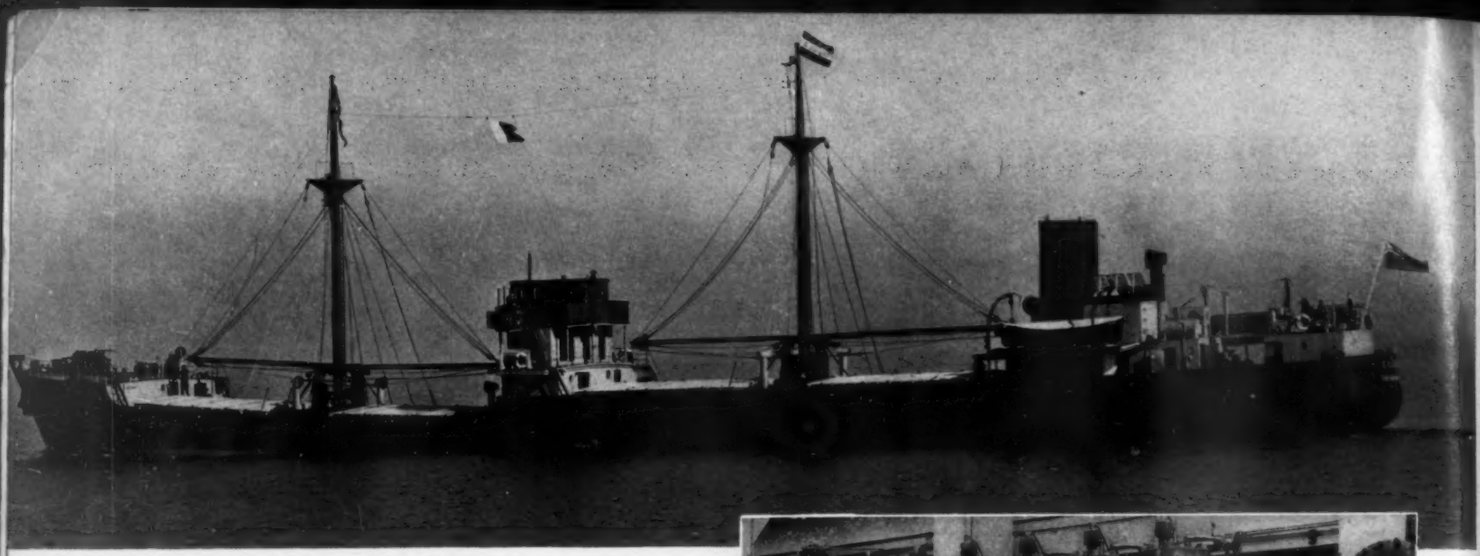
Therefore, the cost of fuel oil for heating 17,814 cu. ft. of water is determined as follows:

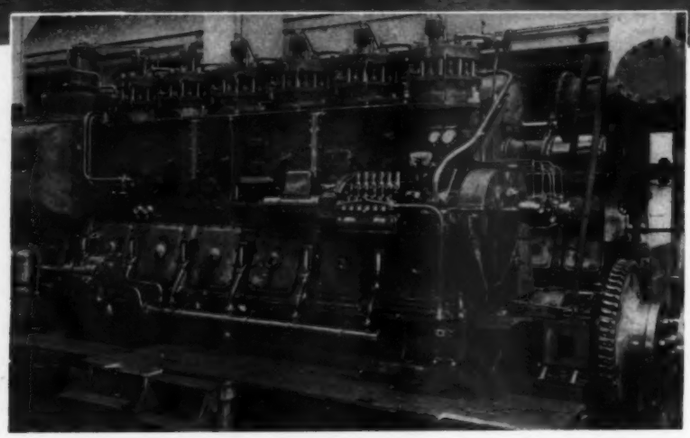
$$\frac{17{,}814 \times 62.4 \times 80 \times \$.0525}{19{,}500 \times 7.45 \times .60} = \$53.56$$

• • • •

Fuel and Lubricating Oil cost to produce 13,980 kwh. electric current and heat 17,814 cu. ft. of water with Diesel plant .. $97.19

. . . . *And now please turn to page 57*





Maierform Diesel collier, "Eildon," and test view of her 870 hp. 2 cycle Atlas Polar engine.

LONDON LETTER NO. 16

By GEORGE LIND

"AT the end of the September quarter there were under construction in the world a total of 131 steamers and 163 motor vessels of up to and under 2,000 tons gross. Among these Great Britain contributed 36 motor vessels and 54 steamers, thus, in this as in other categories, being true to her steam traditions, although at the end of the quarter in question the gross tonnage of motor vessels of all sizes building in our yards was 466,663, as against 459,498 for steamers. The under 2,000-ton category in general embraces the 'small motorship' field, and the Lloyd's Register figures continue a trend which has increasingly manifested itself in the last year or so.

"World figures, apart from Great Britain, show in the under 2,000 tons gross category as at September 30th a definite preponderance of Diesel-engined tonnage, there being 127 motor ships as compared with 77 steamers.

"Diesel-engined vessel superiority showed itself in construction in Belgium, Denmark, Esthonia, France, Germany, Holland, Italy and the United States, steamers being numerically superior in the British Dominions, Finland, Norway, Sweden and Japan – this latter in spite of tremendous development in small motor coasters, known as 'Seatrucks,' operating in the Inland Sea. The small steamer preponderance is worth remarking on in the Scandinavian countries, which otherwise are strong supporters of the Diesel. Cold weather conditions may in part account for this. Three countries alone showed no small steamers building, these being respectively Esthonia, Holland and Italy, and of these three Holland is the most outstanding, because she has no less than 27 motor vessels building compared with the two in Esthonia and one in Italy. These totals cover a vast range of types and sizes, and are a plain indication of the fact that the Diesel engine is steadily encroaching on a field which ten years ago would have been regarded as mainly, if not entirely, concerned with steam."

Thus does A. C. Hardy, B.Sc., A.M.I.Mar.E., A.M.I.N.A., the well-known British motor ship expert, sum up the position of the small Diesel engined vessel in a précis of a paper he read before the Hull Association of Engineers in November of last year. Since then the position has improved still further as far as small motor shipping is concerned, and at the end of December there were over 180 Diesel-propelled craft of less than 2,000 tons gross under construction in the world, as compared to some 130 steamers.

Among the many fine motor coasters completed within the last few months in this country – and the coaster forms the backbone of the British under 2,000 tons category–an outstanding example is the coal-carrying motor ship *Eildon*. Note that last phrase – "coal carrying motorship"! The *Eildon* is owned by George Gibson & Co., of Leith, Scotland, and was built at the Grangemouth Dockyard. She is the first British Maierform collier, and as a motor coaster is one of the largest in service.

The main engine is of the Polar Diesel two-stroke standard type and the auxiliary engines

are by the National Gas & Oil Engine Co. The normal rating of the main propulsion unit is 870 bhp. at 250 rpm., and the contract condition was that a speed of 10.5 knots should be obtained on 810 to 900 bhp. On trials this figure was easily achieved, the actual speed being well over 11.5 knots. The length of the ship is 240 ft. 6 ins. between perpendiculars, and the moulded breadth 37 ft.; the depth is 16 ft. 5 ins., or about 20 ft. 5 ins. to the raised quarter-deck. There is a bridge amidships and the machinery is aft. Four cargo holds are provided. The deadweight carrying capacity is 2,100 tons of coal, together with 55 tons of fuel and 27 tons of water ballast, making a total deadweight of 2,182 tons on a corresponding draught of 15 ft. 4 ins.

The accompanying picture is of the vessel fully loaded and shows her fine lines very well. The other illustration is of the 6 cylinder Polar engine undergoing tests in the Atlas works at Stockholm.

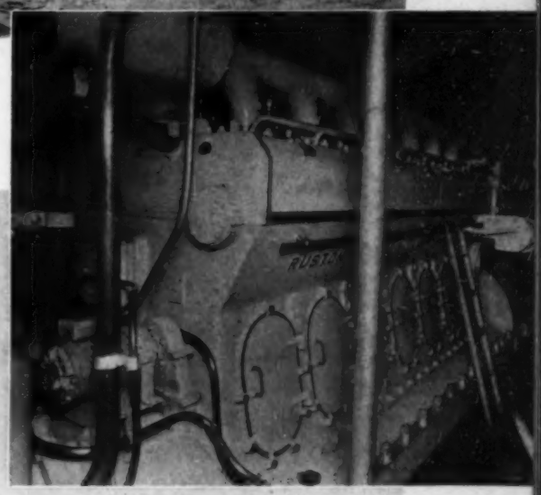
Another and hardly less interesting example of the coaster class is the Ald Shipping Co.'s new motor vessel, the *Castle Combe*. She has been designed and constructed by Charles Hill & Sons, Ltd., of Bristol, and conforms to Lloyd's Register highest class, incorporating a long raised quarter deck with open forecastle.

Special attention has been paid in the construction of the vessel to the accommodation, which is all aft and is extremely comfortable, separate rooms being provided for captain, chief officer, chief engineer, 2nd engineer, with a Captain's saloon and Engineer's and Officers' messroom. The seamen and engine room ratings have a separate messroom and sleeping room.

The principal dimensions of the *Castle Combe:*

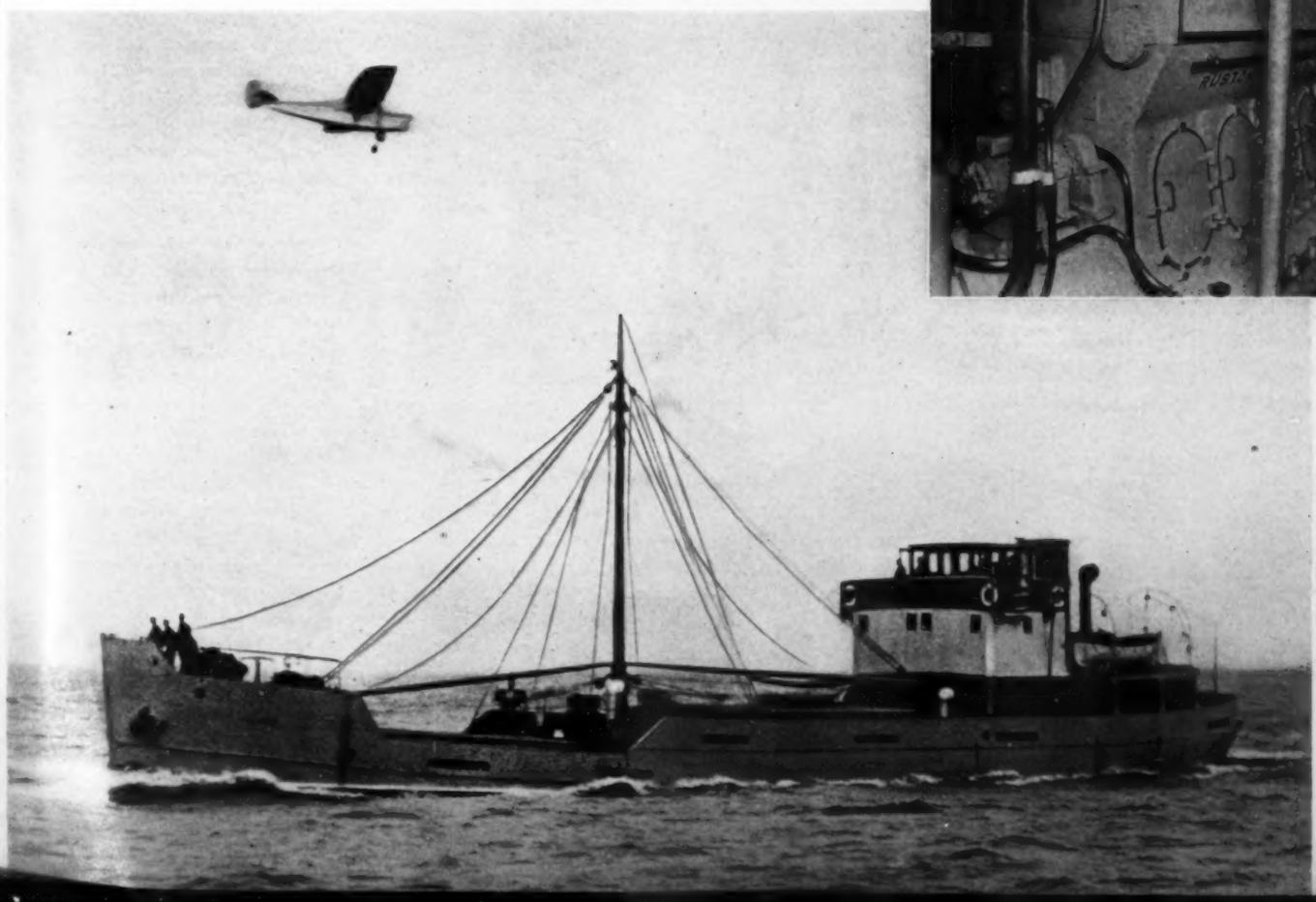
Length	155 ft. B.P
Breadth moulded	27 ft. 6 in.
Depth moulded	10 ft. 9 in.
Load draught	10 ft. 8¾ in.
Deadweight on this draught	630 tons
Gross tonnage	454 tons
Registered tonnage	231 tons

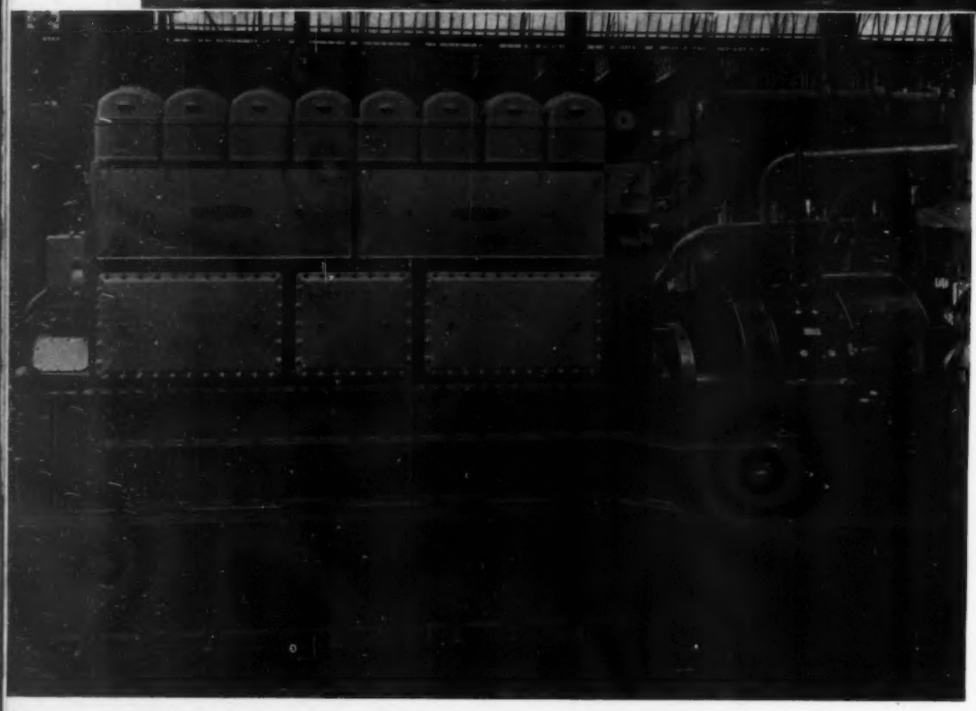
The main engine is a Ruston 7-cylinder unit



Converted Thames tug "Orient" with a 220 hp. National Diesel.

Below — Motor coaster "Castle Combe" on trials and her 500 hp. four cycle Ruston engine.





The Harland & Wolff built tug for The Belfast Harbor Commissioners can be used as a tender, salvage vessel and fire boat as well. One of her 8 cylinder Harlandic Diesels is also shown.

delivering 500 shp. at a normal speed of 430 rpm. The drive is taken through an oil operated reverse-reduction gear with a ratio of 2½ to 1 giving a propeller speed of 172 rpm. The comparatively high engine speed which is made possible by the reduction gear results in considerable economy in the space occupied by the machinery. At the same time the shaft speed is kept low and a slow speed high efficiency propeller is used. The official trials of the vessel took place at the end of last year, and the speed under full power was taken on the measured course both with and against the tide.

Engine rpm.	Duration of run	Speed knots
430	5.54 mins.	10.15
400	6.26 mins.	9.58
375	6.51 mins.	8.8

Shortly after the trials which were carried out from Bristol the *Castle Combe* left with a full cargo for one of the French ports. The day was an absolute "buster," but despite the fact that all the small steam craft were forced to put back to port, the game little motor vessel battled on and reached her destination safely and with the engine running as sweetly as ever —a fine tribute to Rustons and the ship builders.

Turning now to other types of motor craft, Harland & Wolff, Limited, completed last year at their Belfast yard a new twin screw Diesel electric tug, built by them for the Belfast Harbor Commissioners. The new vessel, which is named the *Duchess of Abercorn*, will replace the tug *Musgrave*, which has been in service since 1897.

Many interesting features have been incorporated in her design in order to meet the threefold service of tender, fire and salvage vessel and tug, which she is called upon to fulfill. The combination of Diesel machinery and electric drive gives great flexibility of power, an important consideration in a vessel of this type. The engines have been constructed to develop their maximum horse power at constant revolutions, while the propeller revolutions vary according to whether the vessel is towing or running free. As an effective fire fighting unit the equipment, when in operation, requires anything up to 300 horse power, and with the electric drive this is obtained from the main engine with corresponding reduction of propelling power.

The vessel has been constructed to Lloyd's Register highest class, and to Board of Trade requirements for Steam 4 and Steam 5 Passenger Certificates, and her curved rounded stem, "tumble-home" stern, mast and streamlined funnel complete a very trim craft.

Her principal dimensions are as follows:

Length overall	126′ 9″
Length between perpendiculars	115′ 0″
Breadth moulded	27′ 0″
Depth moulded	12′ 6″

The main engines consist of two Harland-B. & W. high-speed Diesel engines of the vertical forced-lubricated, trunk-piston type, arranged for airless injection of fuel, working on the two-stroke cycle. Each engine has eight cylinders 220 mm. bore, 370 mm. stroke, and is direct coupled to an electric generator having an output of 410 kw. at 550 rpm. The two generators supply direct current to the main propulsion motors, each of 500 shp. Each engine, as well as driving a blower for supplying scavenging air, has incorporated in it the following pumps and auxiliaries:

Lubricating oil pump
Fuel service pump
Bilge pump
Salt water circulating pump
Fresh water circulating pump
Two-stage starting air compressor
Lub. oil cooler and filters

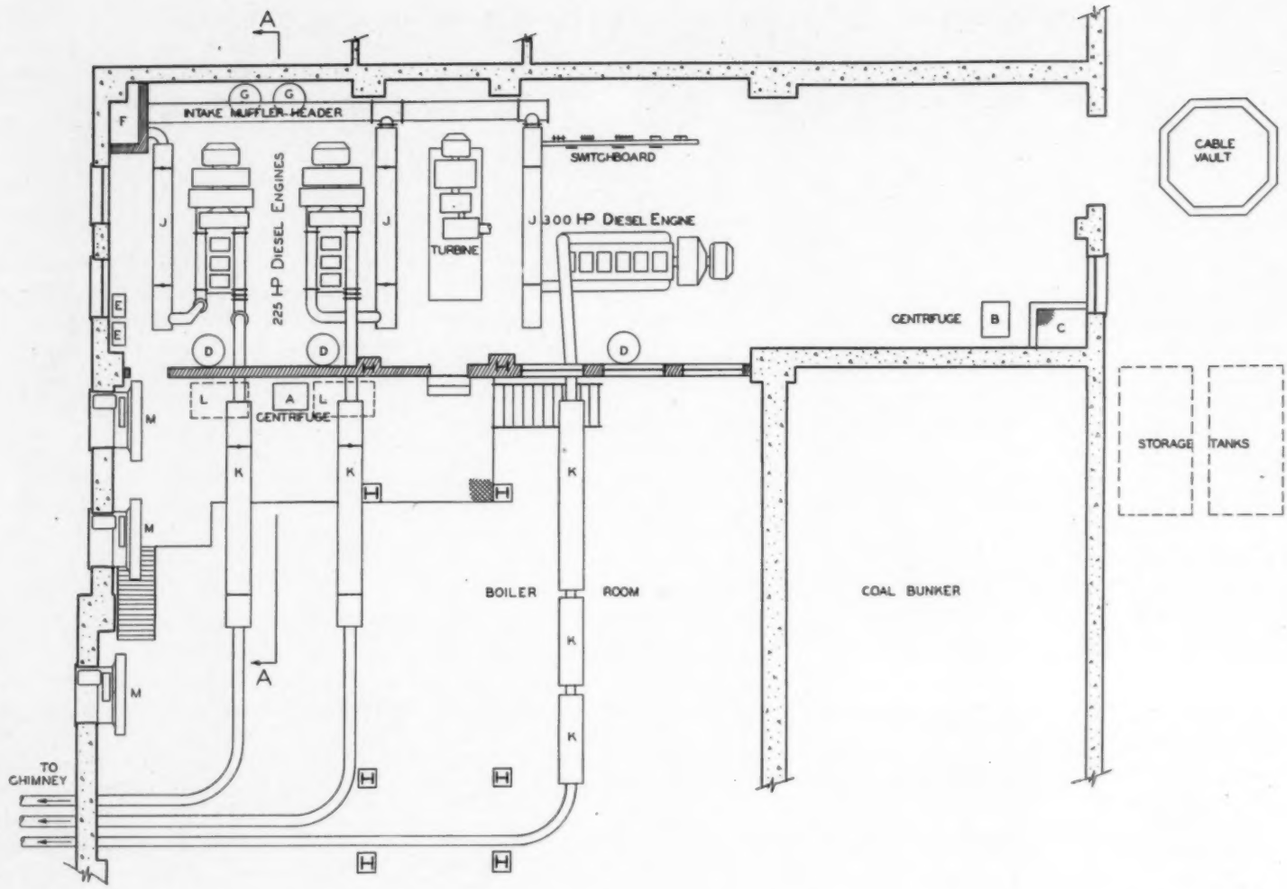
The design of the engine embodies the latest improvements in Diesel engine practice, such as welded steel frames of monobloc construction and the well-known Harland-B. & W. Uniflow system of scavenging, and special silencers, are fitted to the scavenge intake.

The accommodation is on a truly luxurious scale and includes a large dining saloon with seating for 40 people. The decoration and furnishing scheme of this room is a delightful modern rendering of English 18th century decoration, which gives one the impression of being aboard a luxury yacht. The lounge is situated on the deck below the dining saloon and is tastefully decorated with panelled and painted walls, giving the impression of a drawing room in an 18th century English country house. Accommodation is provided for captain, two engineers and crew on the lower deck forward of the lounge, and two large store rooms are fitted, one forward and one aft, on this deck. A large galley with coke-fired range, etc., is arranged with a serving window to the dining saloon.

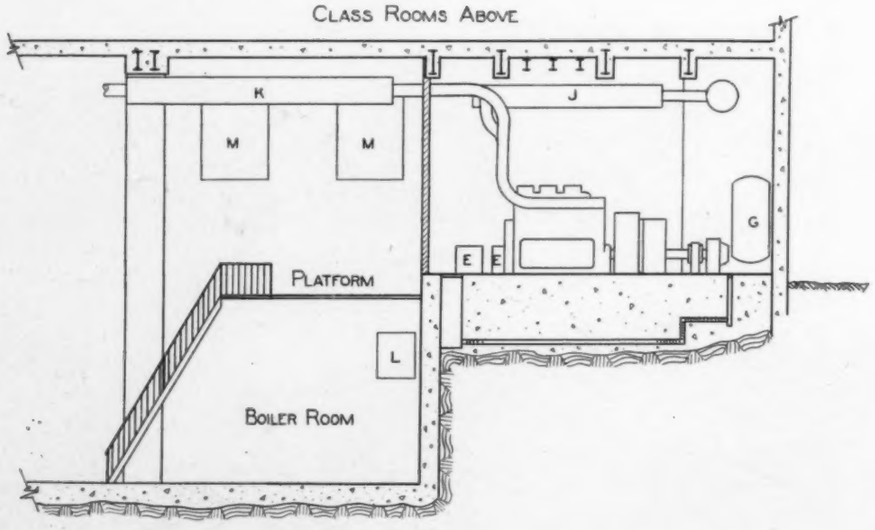
Finally, in this month's report we come to one of the most interesting oil-engined small craft yet produced in this country, namely, the 48 ft. Thornycroft Diesel launch intended for inspection on the Shatt-el-Arab river, running between Basra and Foa in the Persian Gulf. This 24½ mph. craft, which is the fastest British Diesel launch afloat, has to cover the re-

. . . . . *And now please turn to page 56*

The swiftest British Diesel launch afloat for inspection service on the Shatt-el-Arab River to the Persian Gulf. Twin Thornycroft oil engines give a 24½ mile per hour speed.



Plan of New York University Engine Room



SECTION AA

Legend

A. Section Line. See detail.
B. Fuel Oil Centrifuge.
C. Fuel Piping Pit.
D. Day Tanks.
E. Duplicate Air Compressors.
F. Air Chamber Intake from Roof.
G. Starting-Air Tanks.
J. Intake Air Mufflers.
K. Exhaust Mufflers.
L. Lubricating Oil Sump Tanks.
M. Cooling Radiators.

NEW YORK UNIVERSITY USES DIESELS IN UNIQUE PLANT

By ANDREW I. PETERSON*

THE University Heights center of New York University, faced with increasing power plant obsolescence and a load factor unsuitable for existing purchase rates, recently completed a somewhat unique isolated steam and electric generating station to supply the many laboratories and classroom buildings, including the well-known Hall of Fame, that overlook the Hudson and Harlem River valleys.

With rapidly expanding activities at this center, a joint Administration and College of Engineering committee was commissioned to completely survey the problem and to proceed with an entirely modern and complete power plant, not for the large probable economy alone but for educational demonstration. An electric capacity of 700 kw. and a steaming capacity of 1,200 boiler horsepower were installed for the present. But this modest capacity in no way measures the many interesting problems involved in the design, there being incorporated practically all features found in much larger stations. Space does not permit a complete description, and only the general aspects of the electric generating equipment are given here.

Existing facilities were the result of a post-war scrambling growth: where lighting was supplied by direct current steam driven generators of uncertain age, supplemented with an Edison Company breakdown service; power was supplied in two-phase alternating current over a separate distribution; and steam was generated by an educational testing plant, not designed for service purposes.

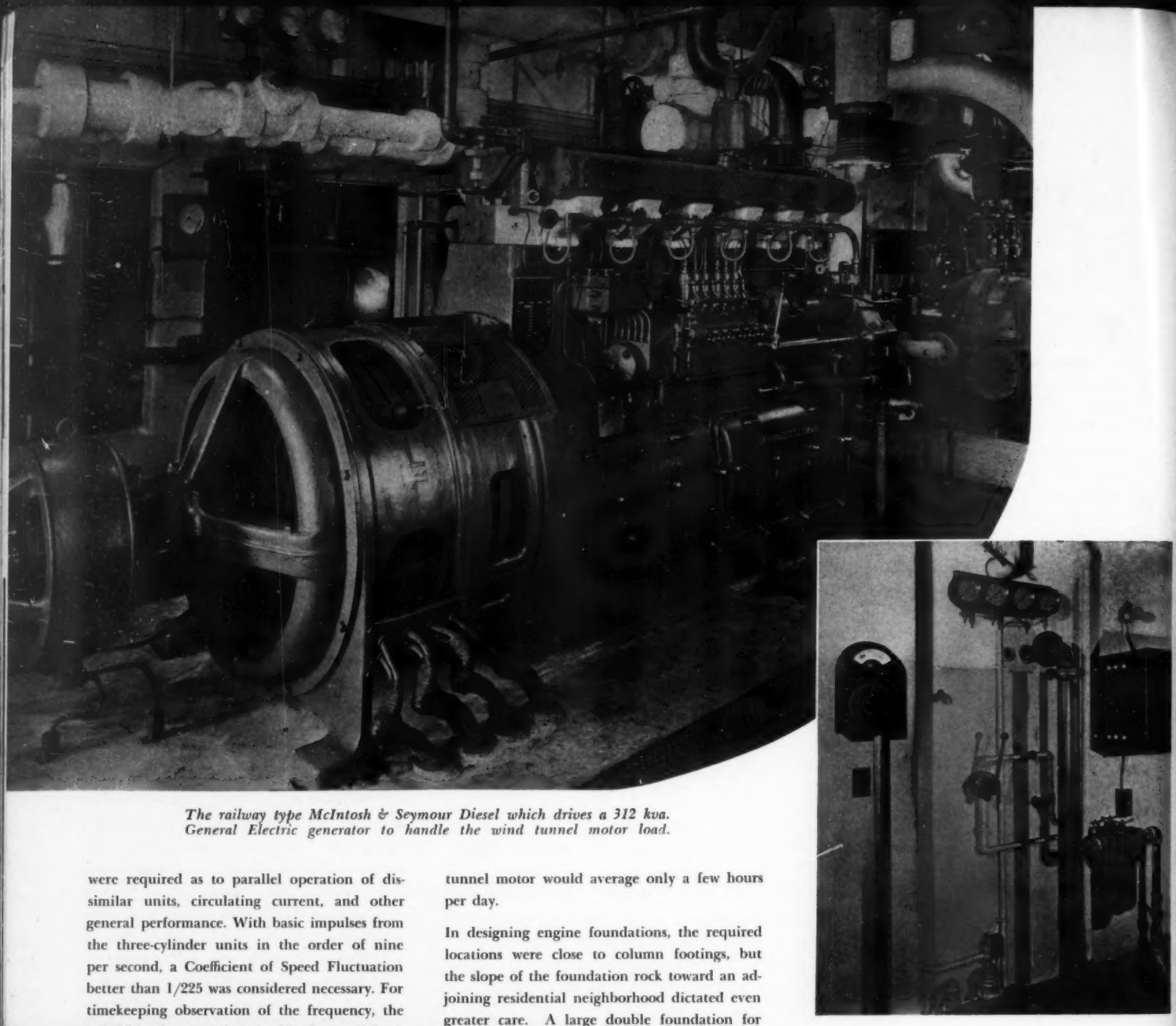
The three-phase, four-wire electric distribution plant provided for an eventual easy conversion of existing feeders to a uniform lighting and power system; with 208 volt power and 120 volt, three-wire lighting permitted from one circuit. High pressure 250 lb. steam generation was chosen as being most flexible for power and laboratory use, with 15 lb. exhaust steam heating.

As typical of other problems in the electric design, where it should be added that the loads presented relatively high maximum demands with low average consumptions, there were such loads as a 310 hp. synchronous motor-generator set at the Guggenheim aeronautical wind-tunnel, a 100 hp. automatic substation unit in the main electrical engineering laboratory, and a 75 hp. induction motor generator in the airplane motor laboratory. In the first case; a sub-transient starting inrush of 438 kva. was estimated, even with a low starting-compensator tap. With a normal load demand otherwise of approximately 250 kw. in lighting and 100 kw. in power, not only would the starting of these units be a problem in generator capacity but would be a serious disturbance before correction took place in the voltage regulators. This would have been particularly serious with a lighting distribution system over 50 acres of campus.

Additional problems were: the adaption of three-phase to the old hybrid system; an exacting frequency control for timekeeping and laboratory work; and a complete elimination of vibration and noise, with engine foundations within two feet of the column footings of the new classroom building above. Educational and architectural limitations added more than usual importance to the complete removal of Diesel intake and exhaust nuisances, and the unobtrusiveness of the Diesel cooling system.

After considerable economic analysis as to type and size of units, there were selected for base load purposes, two 360 rpm. heavy duty, solid-injection, Diesel engines and one non-condensing turbine at 5124 rpm., each driving a 150 kw. alternating current generator continuously rated 187 kva., 3 phase, 60 cycle, 220 volts, 40° C rise, in the latter case through 5124/1200 rpm. reduction gears. In addition there was chosen a 720 rpm., six-cylinder, railway-type Diesel engine with specially designed generator, rated at 312 kva. but with the frame of a 438 kva. machine. This provided reliable means of separately starting the 310 hp. motor, with stable control of voltage. On the base load Diesels first mentioned, the use of three-cylinder engines with A.C. generators, as suggested by other factors involved, was elaborately investigated and careful guarantees written into the contracts. All exciters are directly driven. The Diesel equipment was manufactured and installed, with all piping and auxiliary equipment, by the American Locomotive Company. The engines were equipped with Woodward Type IC governors and Bosch fuel pumps. The General Electric Company manufactured the turbine, generators, switchboard, and all auxiliary motors. In the specifications of both companies, extensive joint engineering analysis and responsibility

*Assistant Professor of Engineering Economics; Resident Engineer administering the construction of the described plant and building.



The railway type McIntosh & Seymour Diesel which drives a 312 kva. General Electric generator to handle the wind tunnel motor load.

were required as to parallel operation of dissimilar units, circulating current, and other general performance. With basic impulses from the three-cylinder units in the order of nine per second, a Coefficient of Speed Fluctuation better than 1/225 was considered necessary. For timekeeping observation of the frequency, the switchboard was equipped with the usual dual-movement electric clock having graduated comparator hands, one movement driven by the bus bar voltage and the other by a small service from the public utility.

This selection provided a turbo-generator, for the obvious economy of non-condensing exhaust to an extensive heating system, and two base-load Diesel units with a combined capacity of 450 kw., although any two units were considered adequate for maximum demands, excepting perhaps two or three extreme cases per year. Summer demands run approximately 150 kw. for which only one heavy Diesel would ordinarily be needed. In addition, the large high speed Diesel is expected to serve as breakdown reserve, since its light use with the wind-tunnel motor would average only a few hours per day.

In designing engine foundations, the required locations were close to column footings, but the slope of the foundation rock toward an adjoining residential neighborhood dictated even greater care. A large double foundation for the two heavy duty units, made of heavily reinforced concrete, was mounted on Korfund cork isolator. The turbine and high speed Diesel units were likewise separately isolated. Full depth trenches were used for side-wall isolation, with steel plate covers and numerous drains in place of the usual cork or sand. This not only provided working space for pipe but guaranteed a dry cork condition at all times. All pipe connections to the engines were provided with exceptionally flexible vibration couplings.

The disposal of engine exhausts also required unusual care. The many conflicting case histories of exhausting into free-standing masonry chimneys made this most desirable solution a subject for specialist consultation. The undesirable possibilities reduced to excessive pulsation and acid condensation in the chimney, particularly during summer months when boiler gases could not assist the chimney circulation. Against the former possibility, each engine exhaust was run separately to the chimney, some seventy-five feet away, through carefully chosen Maxim muffler and wave traps For the second eventuality, an acid-proof lining-mortar was required in the Custodis Company chimney.

Waste heat boilers were carefully considered, but given up because of the insufficient returns in view. These also would have reduced the exhaust gas temperatures too much before reaching the chimney. To further assist in

maintaining these temperatures above the dew point, the exhaust piping was carefully lagged right up to the chimney.

Air intakes were given equal care. Separate mufflers were required on each engine, each large enough for operating without further provisions. In addition, nevertheless, the air was taken from a masonry pulsation chamber and tile duct, leading to the American air filters on the roof bulkhead four stories above.

In providing a cooling system for water and oil, aesthetic considerations prohibited the use of towers or ponds. To obtain the advantages of a closed system, the nearest window openings of the boiler room were used for individual radiators manufactured by the Young Radiator Company. Cooling air is blown outward to an areaway chamber, providing boiler and engine room ventilation as well as insurance against freezing. Positive circulation is provided by pumps mounted on the engines. Variable fan speeds are obtained from rheostatically controlled wound-rotor motors, each equipped with a pilot light warning of shutdowns. Using the waste heat of the cooling water was considered and discarded as uneconomical under local conditions.

The lubricating oil of each slow speed engine is drained to an individual closed sump of 250 gallons capacity, mounted in the adjoining boiler room some three or four feet below the level of the engine floor, and is lifted therefrom by engine-mounted pumps. Tank vents are carried out of the building. The sump of the high speed engine is self contained. All sumps have circulation piping to a Goulds centrifugal purifier, cross-connected by valves for selective conditioning.

Fuel oil is stored outside in two 2,500 gallon tanks below ground, with completely separate piping from each tank to another centrifugal purifier. From the purifier, common feed and overflow lines run to the day tanks above each engine. Although the fuel leaves the day tanks by gravity, it passes through booster pumps on each engine. This arrangement permits oil to be selectively pumped from either storage tank to any day tank, or from one storage tank to another for cleaning or segregation of different grades. At present, a No. 2 oil is used, although a No. 4 is planned for as soon as the plant is shaken down.

A Brown pyrometer with individual couples for all Diesel cylinders in the plant, with multipoint switch, is located near the cooling fan controls in the engine room. On the engines are mounted alarm relays for lubricating oil, water and fuel systems; also automatic stop relays for overspeed, lubricating oil and water temperature.

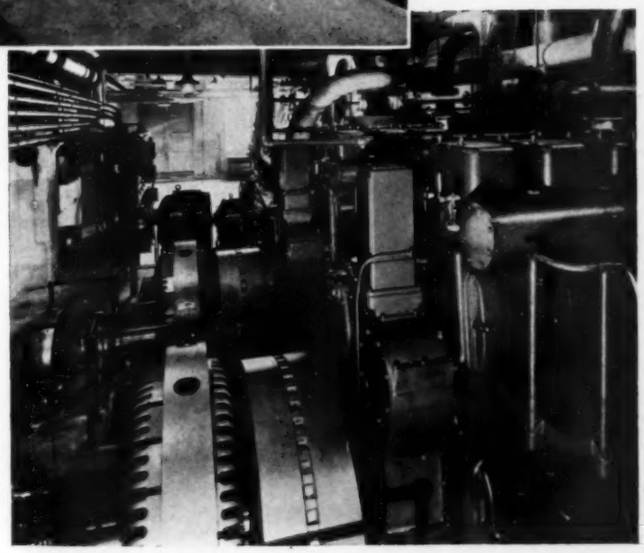
The switchboard is of modern dead-front construction, with four generator, one totalizer, and two distribution sections. Oil circuit breakers are used for paralleling generators to the bus. Engine and turbine governors are motor driven and controlled from the board. General Electric type GDA voltage regulators for all generators are mounted on the totalizer panel, with back-mounted cross-compensation equipment for controlling load between machines. Distribution is controlled by 600 ampere dead-front knife switches, since feeder disconnection is very rare.

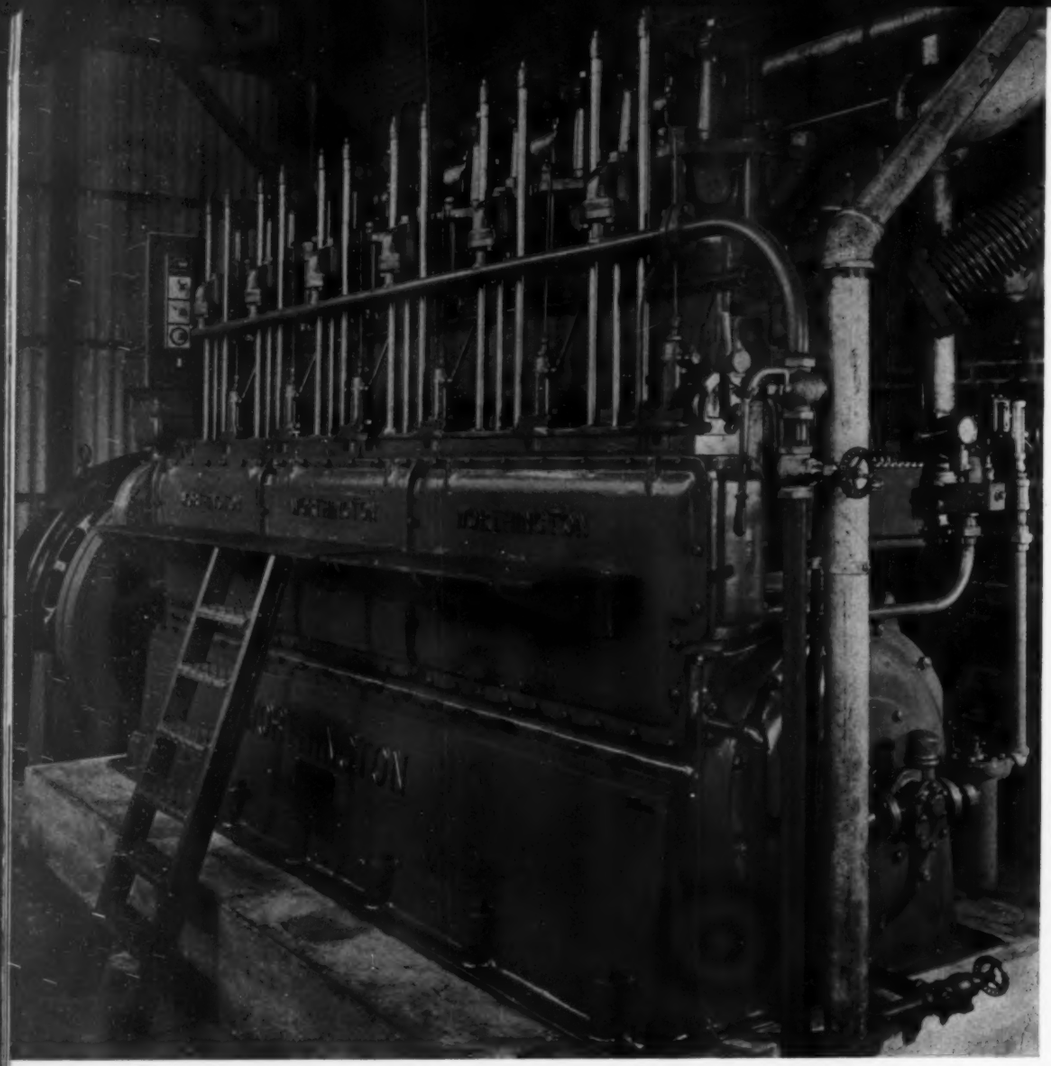
In the case of the high-speed Diesel generator panel, the feeder for the 310 hp. motor mentioned above is connected directly to the generator, between the generator and the O.C.B. to the bus bars, and protected by a back-mounted 1,200 ampere fused disconnect switch. Remote control push-buttons on the same

. . . . *And now please turn to page 55*

Left: One Brown pyrometer serves all three engines. It is wall mounted as are two Cuno Auto Klean lube oil filters. Right: Maxim air intake silencers are visible above the switchboard.

Below: Two views of the twin 150 kw., heavy duty McIntosh & Seymour Diesels at N. Y. U. The Woodward governors appear just above the flywheels.





The 300 hp. Worthington Diesel-Ideal generator unit now generating power to manufacture chemicals. This unit supersedes forty years of steam operation and purchased utility power.

ZINSSER & COMPANY, INC.

Manufacturing Chemists Since 1897

ONE of the first new Diesel installations to assume its intended load in 1937 was the 300 hp. 6 cylinder Worthington unit now operating for the Zinsser Chemical Plant at Hastings-on-the-Hudson. For the past forty years, during which this company has earned an enviable reputation for itself and its products, necessary power has been either steam generated or purchased from the local public utility. It is interesting, therefore, to investigate the circumstances which prompted the selection of Diesel generated power and the resultant Diesel installation.

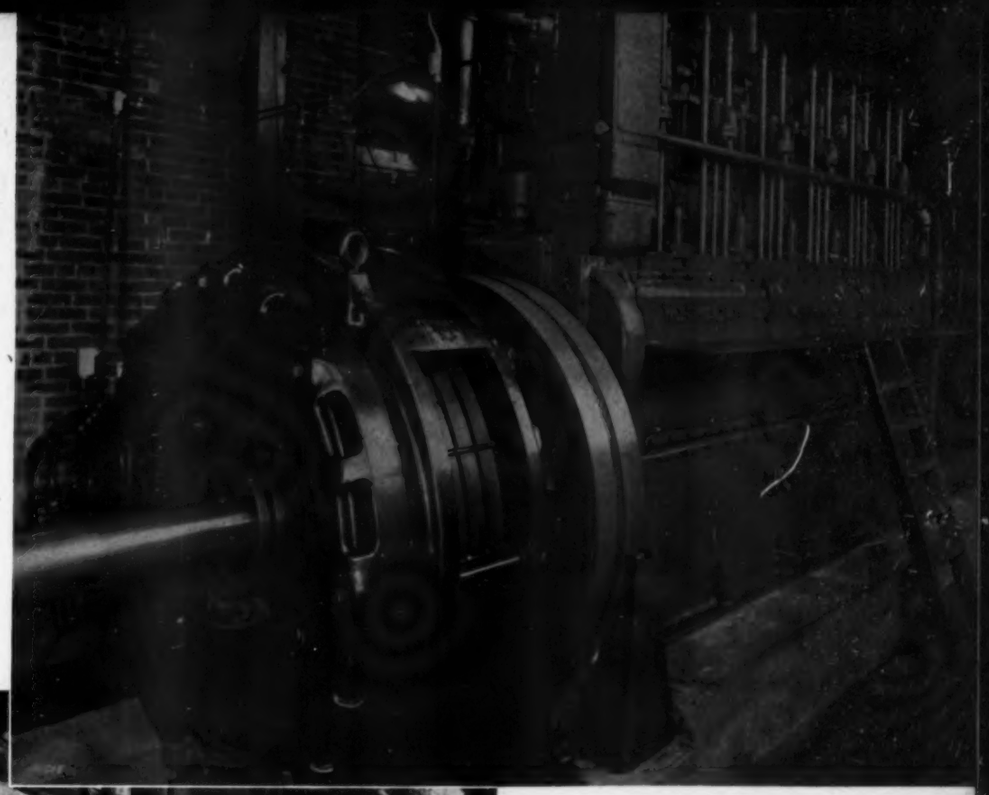
During the World War period the company was producing mustard gas for the United States Chemical Warfare Service and continued these operations until 1920 when it returned to private business in the synthetic organic field, developing a complete line of alizarine, azo and basic dyestuffs. Six years later a consolidation took place with the Ultro Chemical Corporation for the purpose of extending operations to include high grade color lakes, toners and paint pigments. A thoroughly modern dry color plant was then erected at Hastings.

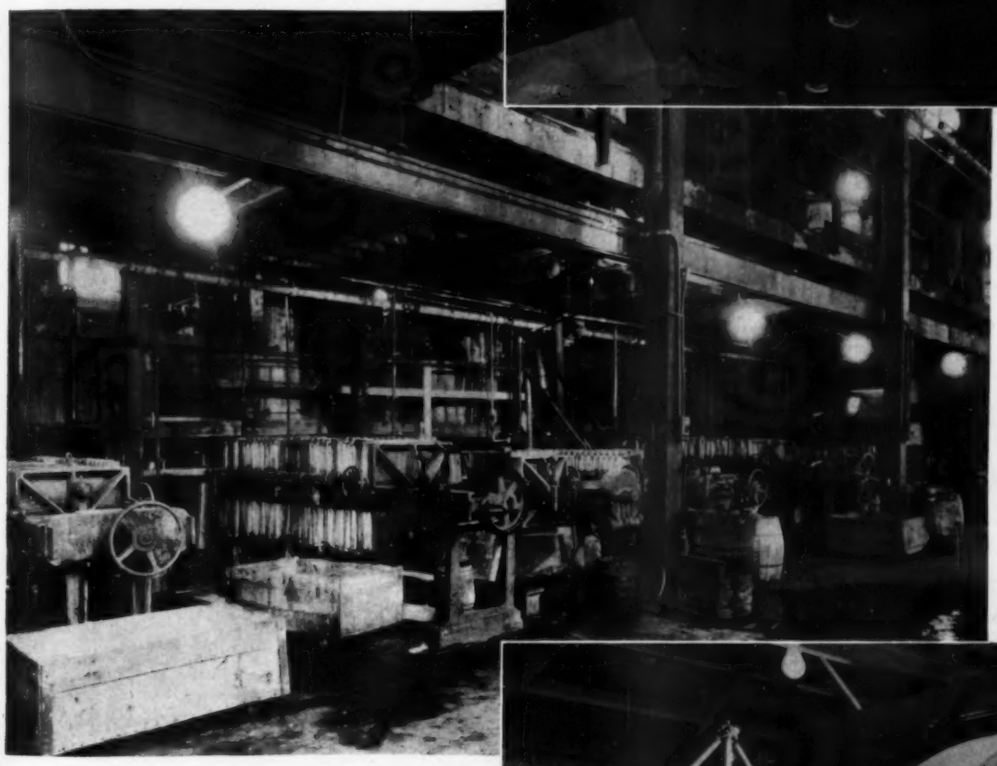
Up to this time, the company had generated its own power with two Corliss steam engines of 140 hp. and 170 hp. capacity respectively. With the enlargement of plant facilities and the resultant power demand increase, these two steam units were shut down and connection was made with the utility. This arrangement continued until the long-to-be-remembered year of 1932 when stringent economic conditions forced a termination of the purchased power contract in favor of the more economical old steam engines once more. In August, 1935, a broken connecting rod forced the company to revert to utility power. It was not long after this eventuality that Zinsser & Company decided to settle the problem of securing *power which was both economical and dependable* and their modern Diesel generating plant as it stands today is the result.

The Worthington Diesel is directly connected to a 200 kw. Ideal generator with V-belt driven exciter. Short period peak loads and standby service are handled by the previously mentioned Corliss engines. Since there is considerable demand in the plant for process steam, a boiler is always fired and available for the above contingencies.

To a casual observer outside the powerhouse, there is practically no indication that an engine is operating. Exhaust noise and vibration are effectively subdued by a Maxim silencer and the Diesel runs so smoothly that it is possible to balance a nickel on edge at any point, even on the pedestal bearing. Further auxiliary equipment mounted integrally with the engine includes a Woodward governor, Vortox air intake cleaner, Alnor exhaust temperature pyrometer and Cuno filters on both fuel and lubricating oil lines.

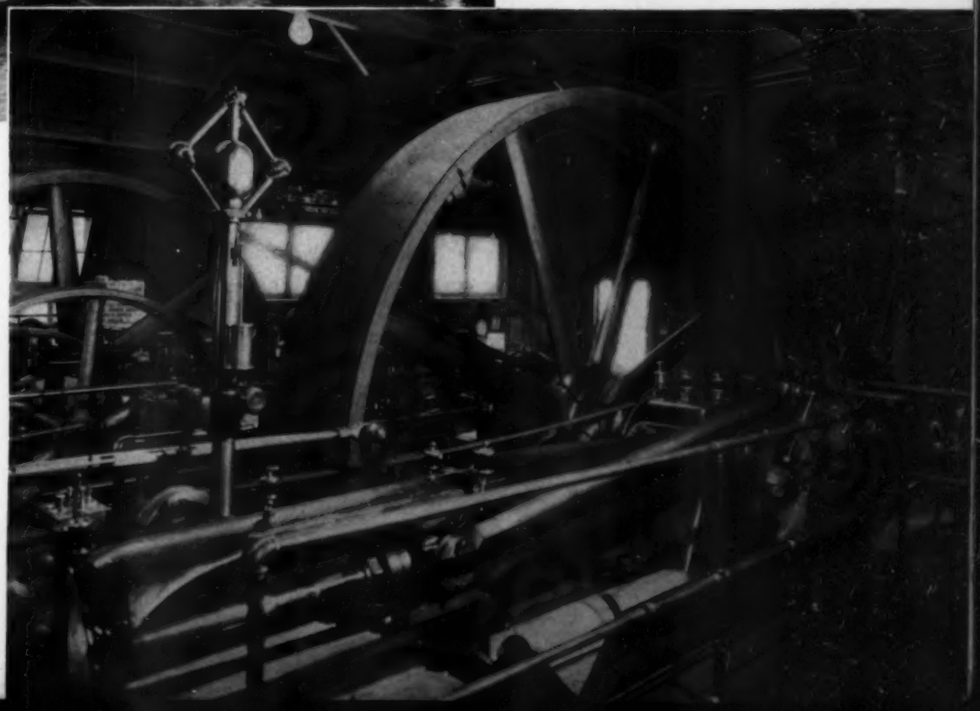
Mr. Berston, President of Zinsser & Company, expressed complete satisfaction with his new Diesel unit and is to be congratulated upon his entire equipment assembly. His company enjoys an enviable position in the chemical industry, being well established in three major branches of the synthetic organic field. Its business includes such items as Pyrogallol, Hydroquinone and allied products which are sold extensively to the motion picture and photographic industry. Dyestuffs consist of Alizarine Blue Blacks, Cyanine Greens and Asterols together with Celanese and Azo colors which are widely used in the preparation of woolens, silks and cottons. A diversified demand from the ink, paint and lacquer fields is consistently maintained for Zinsser manufactured dry colors such as Yellows, Oranges, Blues and Reds.



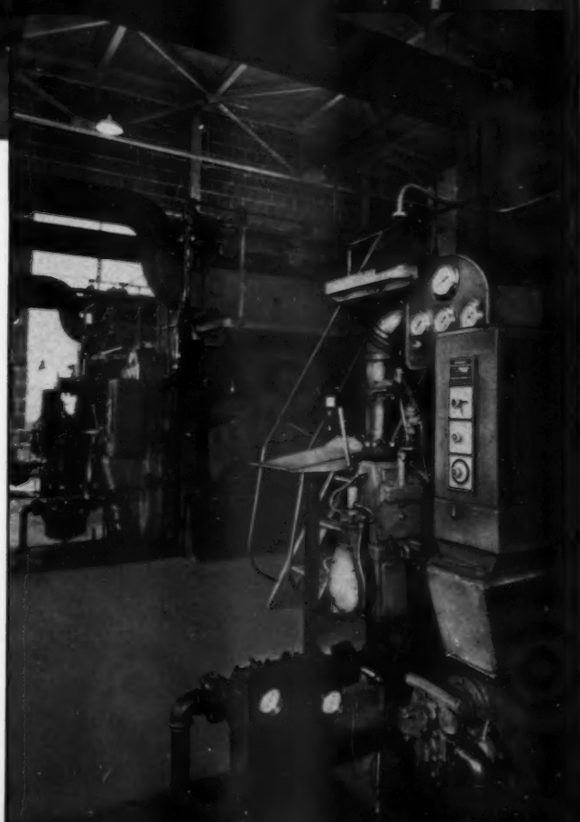


Left — Filter presses at Zinsser & Company used in the manufacture of dry colors.

Below — The two great Corliss engines which function only for peak load periods and for standby service. Their combined power is less than that of the Diesel regardless of the comparative sizes.



MODERN AS TOMORROW !



Edge Moor, Delaware, took a long industrial stride when the Ludlow Manufacturing and Sales Company selected that point as the site of its most recent development.

The new power plant proper houses 2210 kw's. A 110 kw unit furnishes light and power for such times as the mills are not operating. But the primary plant consists of three 1000 H. P. Winston Diesel Engines...each directly connected with a 700 K.W. alternating current generator.

These engines, of Winston standard design, are 8 cylinder, 4 cycle mechanical injection type. They are placed with center lines parallel, and are spanned by a ten-ton overhead crane in the interest of economic maintenance.

Clearly, this installation is the last word in both engine design and power house arrangement...and as is so frequently the case on both large and small Diesel units, Purolator Filters protect both the fuel and lube oil supply.

Purolator engineers have kept abreast with every development in the Diesel field . . . and solicits your inquiries. Motor Improvements Incorporated, Newark, New Jersey, makers of

PUROLATOR

The Oil Filter

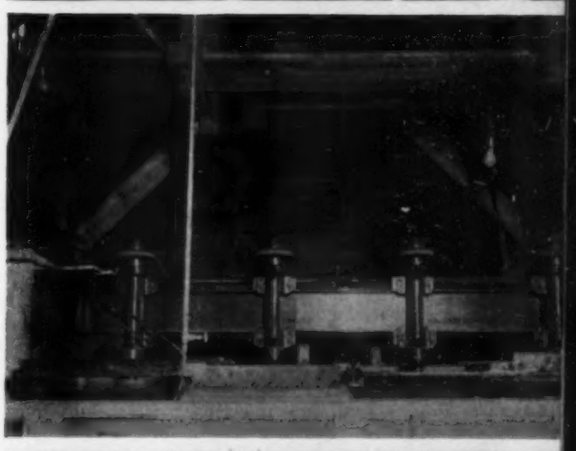
ATLAS DIESELS Furnish Power For Gem of Sparta Mine

Left, Gem of Sparta Mine, Sparta, Oregon, showing stamp mill and ore chute.

Right top, a 6-cylinder, 140 hp. Atlas Diesel which drives an air compressor to supply the drill runners underground.

Right center, stamp mill, agitators and concentrating table driven by the Atlas Diesel shown above.

At bottom, a 4-cylinder, 80 hp. Atlas Diesel which drives the mill and a 10 kw. generator.



METAL MINING represents one of the industrial applications of Diesel Power in which the reliability and economy of the Diesel show up to the best advantage. Usually located far off the beaten path, in mountainous regions that are swept by winter blizzards and ravaged by forest fires in the summer months — they must be assured of a dependable power supply. A mine is a dead loss when the power is shut off.

In these inaccessible locations, Atlas Diesels are famed for their absolute dependability in furnishing a steady flow of power. Fuel costs are low, and an Atlas Diesel uses just half the number of gallons as a gasoline engine of equal power — so that reduces storage and transportation costs. When mountain roads are blocked with snow the Atlas Diesel powered mine continues to hoist rock and grind ore, uninterrupted by the hazards of wind, ice and fire that beset the transmission lines in mountainous territory.

With metal prices favorable, many a mining property which was previously regarded as a marginal producer, is opening up with Atlas Diesel power and proving itself a money maker. Many a prospect is being developed with a portable Atlas Diesel power unit which carries on until the property is proven and a permanent power plant is installed.

Atlas Diesels, in portable and stationary models, are available in a wide range of sizes, suitable to almost any mining or milling operation. The application of Diesel power to metal mining and ore milling is covered in detail in our Catalog No. 934-F. We will gladly mail a copy to any mine operator or owner who requests it on his business letterhead.

ATLAS IMPERIAL DIESEL ENGINE CO.
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ATLAS IMPERIAL

FUNDAMENTAL REQUIREMENTS FOR HIGH-SPEED DIESEL ENGINES

By B. J. VON BONGART

THE larger present-day Diesel engines operate at a piston speed rarely exceeding 1,000 ft. per minute. The smaller engines of today may reach speeds up to 2,200 ft. per minute, but such engines are limited to automotive applications, such as trucks, buses, etc. and perhaps motorboats.

Yet there is a tendency towards higher engine speeds in the entire field. Abroad, piston speeds of 1,500 ft. per minute and over are no longer exceptional for large engines, and in the small engine class, speeds have reached the 2,500 ft. per minute mark.

The question naturally arises as to just what are the limiting factors and how far one may safely go in the matter of speed.

For large engines, the factor of inertia definitely limits the rotative speed of the masses, which in turn determines the piston speed in any given case. For small, strictly high-speed engines, the ignition lag and the delayed combustion have been considered as the limiting factor, however wrong this view may be; speeds of 4,000 rpm. and over have been reached in the laboratories, and engine speeds of 3,500 rpm. in ordinary everyday practice, insofar as skillfully designed Diesels are concerned. We know now that the factors of speed limitation are the pumping and friction losses. In the following, an attempt is made to clarify this point.

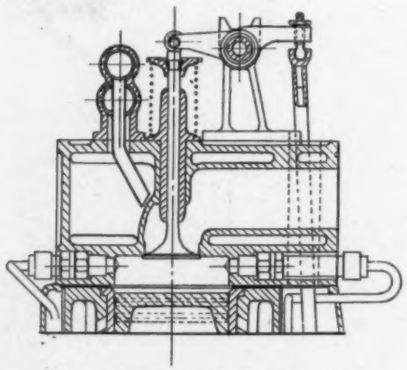

Fig. 1. Open-chamber Diesel Engine.

*The various chamber constructions shown are not tentative designs nor Patent Office illustrations. They depict chambers in actual use today. Since this article is intended as an academic discussion and not propaganda for or against any one chamber construction, the designs are not further identified.

In Fig. 1 is illustrated an "open-chamber" Diesel engine, i.e., an engine where the circular clearance space between the piston-head and the underside of the cylinder-head is utilized as the combustion chamber. This type of construction is favored by many in spite of its apparent faults with regards to high-speed performance. The very maximum of turbulence is the *sine qua non* of refined Diesel engine performance, but such open-chamber construction does not build up turbulence to an appreciable degree. Yet this type of construction possesses a virtue not to be minimized, namely, that it shows the very lowest pumping losses. Here, the pumping losses are directly proportional to the compression ratio; and the friction losses, both piston (plus ring) and bearing friction, also depend entirely upon the pressures imposed upon them by the compression and combustion pressures. But such engines are comparatively inflexible: they require high compression ratios, which are undesirable in many respects. The ignition-lag is great even with dual-nozzle fuel injection; the latter is necessary for large bore engines so as to obtain a more uniform fuel distribution, and for high-speed engines turning up to 2,000 rpm. (for a stroke of from 6 to 7 inches) in order to reduce the ignition lag. To be sure, aside from the fact that the "open-chamber" construction is free to all (no patent limitations preventing anybody from using this design) whereas practically all chamber layouts are covered by Letters Patent, the construction (Fig. 1) possesses certain merits as well as shortcomings. Nevertheless, it is a type of construction totally unsuitable for really high-speed engine performance, and especially so where extreme flexibility is demanded.

In Fig. 2 is shown an "ante-chamber" construction which by common consent has been named turbulence chamber. This arrangement produces the very maximum of turbulence in that the air whirls around and around within the spherical chamber with the result that intimate mixing of the air-fuel molecules thus takes place. Unfortunately, such a chamber produces also the very maximum of pumping losses, since the compressing air during the upward movement of the piston is squeezed through the rather narrow orifice which connects the spherical chamber with the combustion chamber proper. Also, the force of the combustion is minimized, since the burning fuel-air mixture in passing out through the narrow channel loses much of its force, whereas the expanding force of the burning mixture should bear directly against the piston for useful work rather than be partly spent in the friction losses encountered in restricted channels. The pumping losses inherent in such construction are well recognized by experienced designers: Fig. 3 illustrates an attempt to minimize the pumping and friction losses within the channel. But here, the incomplete sphere offers diverting abutments to the whirling fuel-air mixture, which hamper the necessary turbulence, although the wide channel does reduce the pumping losses considerably.

The chamber construction depicted in Fig. 4 consists of an elongated sphere, practically an ellipsoid. This design features not a single narrow orifice but rather a number of tiny holes. The so-called turbulence chamber is separated from the main combustion chamber by a perforated steel disk, against which the fuel stream is directed. The ignition lag is of

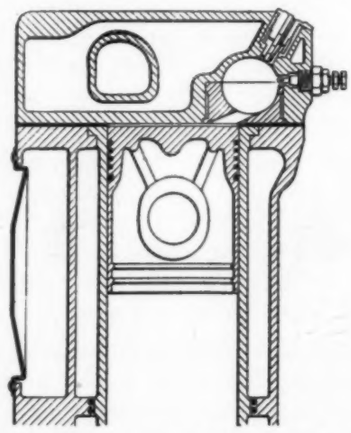

Fig. 2. Turbulence-chamber Diesel engine (*)

but short duration, but the turbulence is far less than that of the construction shown in Fig. 2 and the pumping losses are immense, due to the restriction caused by the finely perforated

. . . . *And now please turn to page 52*

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HIGH SPEED DIESELS

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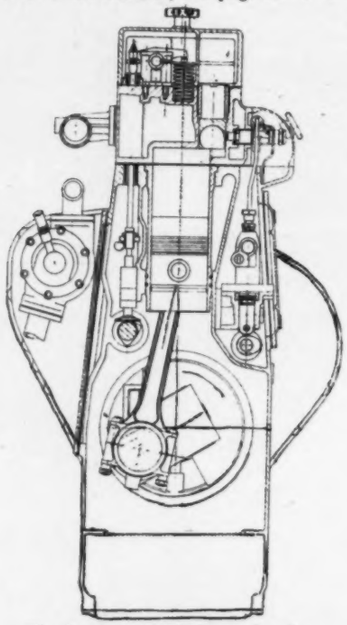

Fig. 3. Open turbulence-chamber.

disk. An automobile Diesel engine featuring the above chamber design delivers 50 hp. at 2,000 rpm., the motor having 4 cylinders $3^{15}/_{16}$ inches bore and $5^1/_8$ inches stroke; the compression pressure is 465 lbs. per square inch. The fuel consumption is but 0.38 lb. per hph., a point worth considering. To the best of the writer's knowledge, it has not been possible to increase the engine's speed beyond 2,000 rpm. (piston speed app. 1,700 ft. per minute) primarily because of the unprecedented pumping losses unavoidable with such design.

The chamber construction illustrated in Fig. 5 is a container shaped like an inverted bottle, entirely closed except for a narrow opening towards the combustion chamber. This design does not build up what may be termed turbu-

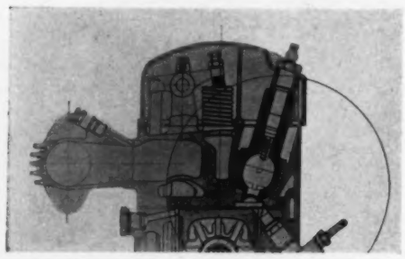

Fig. 4. Semi-turbulence chamber.

lence, but produces a blast-action. As can be seen, the ante-chamber is rather well insulated: most of its surface does not come under the influence of the water cooling, the tip of the chamber being completely insulated from any cooling tendencies by an air space. This then means that the chamber acts as a catalytic igniter, and hence this engine is not a Diesel in the strict meaning of the word. The glow plug shown is used for starting purposes only, of course.

A small 6-cylinder automotive Diesel engine of $3^7/_{16}$ inches bore and $4^{15}/_{16}$ inches stroke embodying the chamber design as depicted in Fig. 5 produced the following results: At 2,000 rpm. – equivalent to a piston speed of 1,650 ft. per minute – it developed 66 hp., and a torque of 188 ft. lbs. A compression ratio of $19^1/_2 : 1$ resulted in a compression pressure (P_2) of 780 lbs. The flexibility of the motor in question is excellent, ignition even at lowest idling speed unfailingly certain, but its fuel consumption of 0.485 lb. per horsepower hour is rather high. It is not possible to raise the piston speed (under load) beyond 1,700 ft. per minute, unquestionably because the excessively high pumping losses with the added gravamen of high friction losses, prevent it.

Fig. 5. Ante-chamber Diesel engine.

While a lower compression ratio would reduce piston and bearing friction considerably, it would not materially affect the friction-pumping losses at the passage leading into the ante-chamber. It seems safe to predict that a large engine with a bore of 12 inches or thereabouts could not possibly operate at piston speeds of over 900 ft. per minute, if handicapped by such chamber design and altogether too high compression ratio.

The pear-shaped ante-chamber (Fig. 6) also produces an undesirable blast action and practically no turbulence. A 6-cylinder motor embodying this chamber design and intended for trucks produces but 70 hp. for a cylinder size of $4^1/_8$ inches bore and $6^1/_2$ inches stroke. The engine rpm. of 1,300 rpm. and hence the piston speed of roughly 1,400 ft. per minute cannot be increased under load. The compression ratio of this engine is 14.7 :1 and produces a brake-mean-effective-pressure of but 83 lbs. per sq. in., ample evidence that the expanding

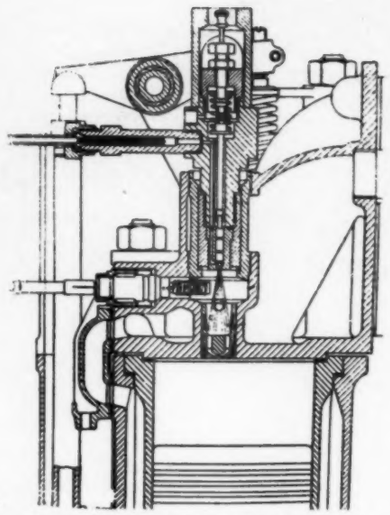

Fig. 6. Pear-shaped ante-chamber Diesel.

force of the combustion is wasted in blasting rather than in useful pressure against the piston. Attempts were made to increase the brake-mean-effective-pressure, but these resulted in smoky exhaust and excessive fuel consumption, indicating imperfect combustion and waste of fuel. A maximum pressure of 110 lbs. was reached, which could not be exceeded at any cost, and the blasting action of the ante-chamber resulted in frequent piston fractures. What the results might be for large bore engines can well be imagined.

In Fig 7 is illustrated a doughnut-shaped ante-chamber which also produces a blasting action and not much turbulence. The pointed pis-

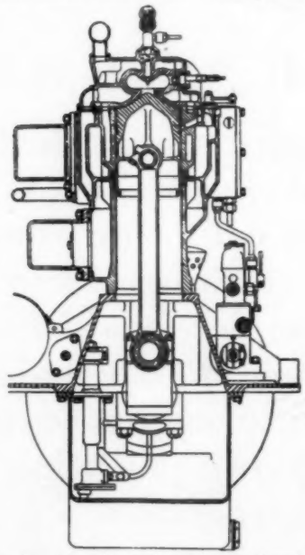

Fig. 7. Doughnut-shaped ante-chamber.

ton is an ill-chosen design, giving rise to localized overheating. On the whole, it is a chamber construction not favored by experienced designers. *And now please turn to page 54*

SERVING A FIFTH AVE. OFFICE BUILDING

ECONOMY dictated the installation of a combination steam and Diesel generator plant in the building at 586 Fifth Avenue, New York City.

In order to obtain this economy and at the same time secure freedom from noise and vibration, which in a large office building are of equal importance, Ingersoll-Rand Type "S" engines were selected.

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HIGH SPEED DIESELS

. . . . *Continued from page 52* . . . .

Referring again to Fig. 1, a motor of 6 cylinders of 4.6 inches bore and 7.8 inches stroke embodying this open-chamber design develops 90 hp. at a speed of 1,300 rpm. The very low compression ratio of but 11½ : 1 is responsible for the very moderate compression pressure (P_2) of only 360 lbs. per sq. inch. The combustion pressure, Pmax was found to be 618 lbs. per sq. inch, netting a brake-mean-effective-pressure of 82.3 lbs. The fuel consumption is moderate, only 0.38 lb. per hph. The efficiency of the engine was found to be as follows: Heat generated 100%

32.0% transformed into useful work
30.3% lost in cooling water
30.3% lost with the exhaust gases
2.5% lost by radiation
4.9% pumping and friction losses.

Due to the very moderate compression ratio, the percentage of heat transformed into useful work is somewhat low, but it must be borne in mind that the pumping and friction losses are also very low for the same reason. All attempts to speed-up the engine rpm. failed; a piston speed of app. 1,730 per minute is manifestly all that could be hoped for with such a sub-normal compression ratio.

Analyzing the losses of an engine in so far as pumping and friction losses are concerned, one finds that the pumping losses of an "open-chamber" Diesel (Fig. 1) are the lowest possible. The friction losses in pistons and rings are effected by the compression pressure, and the bearing friction in turn also by the compression pressure. But engines with intricate chamber designs and narrow passages are burdened with the additional friction losses caused by forcing compressed air through small orifices. Hence all engines with extra chambers show higher losses than open-chamber engines, but since the latter do not permit high engine speeds, the former are desirable in spite of extra losses. But the above air-chamber Diesel could successfully operate at a speed of 3,500 rpm. (piston speed 2,765 ft. per minute), which would be utterly impossible for the low-loss open-chamber engine. And for the former, 3,500 rpm. was the maximum rotative speed, not on account of ignition – failure or even uncertainty, but rather because increasingly higher and ever higher pumping and friction losses ate up all gain at piston speeds in excess of 2,765 ft. per minute! *Summa summarum*. The fact that, according to the poet, there is "no unalloyed bliss" in this world is proved by the issue, open-chamber vs. pre-chamber Diesel. Each type has its faults and we simply must tolerate one or the other. Since high-speed Diesels are in demand, pre-chamber designs must be adopted in spite of their shortcomings. But there is a crying need for better chamber designs. While it may never be possible to equal the low losses of an open-chamber with complicated turbulence-chamber designs, yet we must approach them. Turbulence, maximum turbulence, is needed for high-speed engines so that auto-ignition may take place with the very minimum of lag. Open chamber engines cannot operate at high speeds and refined pre-chamber engines operate at great losses; a modern variety of the Scilla and Charybdis.

The weary Diesel-engineer may say that the two demands are irreconcilable, that they resist perfect union as much as oil and water. But a way will be found to combine the low losses of the open-chamber design with the speed possibilities of an efficient turbulence chamber, because it simply must be found if the high-speed Diesel is to be a reality. Scientific research will provide the answer. And, irrespective of whether the fact is universally recognized or not, the truly high-speed Diesel is as near as – tomorrow.

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NEW YORK UNIVERSITY

. . . . *Continued from page 45* . . . .

panel, for starting this motor in another building, are interlocked with the O.C.B., so that the motor cannot be started again after the generator is on the line. If research workers at the wind-tunnel should trip the safety stops, the engine operator cannot accidentaly burden the line bus with the starting inrush. Pilot lights on the panel indicate the running and idle conditions of the motor-generator set. In thus being able to parallel the generator after it is carrying the motor-generator, the otherwise idle capacity of the generator can be utilized. The wind-tunnel equipment is designed for 100 miles per hour wind-speed on a short-time rating, but operates most frequently at a velocity of 60 mph. As the required power falls off as the cube of the air speed, an average need for running power is about one-third of the new generator capacity.

The Diesel starting-air equipment consists of one electrically-driven compressor, with a duplicate reserve gasoline-driven unit.

In general, the performance of the plant is very promising, but operating data obviously will not be available until after a considerable period of shaking down and finding the optimum operating balance between all the factors of the entire plant. In the present adaption of the existing distribution to the new system current the results have been satisfactory, the single phase lighting being in unusual balance with uncanny regularity and the motor starting loads being barely perceptible at the plant.

With the expected growth of load, and the increase in even the present economies, consideration of much larger units for both Diesel and steam is expected. Adequate space has been provided for such expansion.

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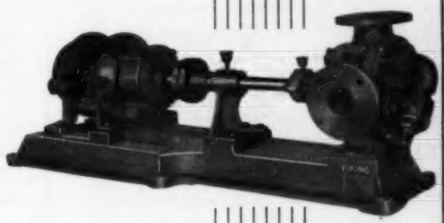

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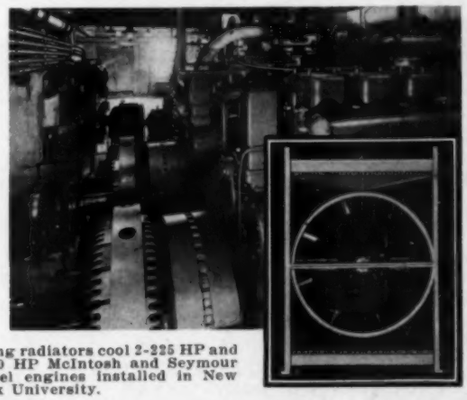

Young radiators cool 2-225 HP and 1-300 HP McIntosh and Seymour Diesel engines installed in New York University.

Young Radiators for Cooling Diesel Engines

● Diesel engine jacket water and oil cooling radiators built by Young are carefully engineered to fill your specific requirements as to weight, size, cooling capacity, and power consumption. Modern laboratory facilities and thousands of Young radiators operating in the Diesel field provide a knowledge of the needs and requirements of engine builders. This service is available without cost or obligation.

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Isolates
DIESEL
VIBRATIONS

•

At New York University the students are not disturbed by vibrations—even though there are classrooms directly over the Diesel engines. Tenants in the neighboring apartment houses don't know the engines are running—and there are unfavorable soil conditions from the engine site to the apartments.

No transmitted vibrations mar this excellent installation. No excessive wear due to vibrations rebounding into the engine. No trouble from neighbors. Smoother operation. All because these Diesel engines are isolated with a Korfund Anti-Vibration Product.

Similar conditions were met on the Diesel engine installation at Rockville Centre, Two Park Avenue, The Namm Store, R. H. Macy & Co., Hotel New Yorker, and a host of others. On all of these, Korfund Anti-Vibration Products were used. So on none is there any annoyance or expense from transmitted vibrations.

You, too, can profit by using Korfund Anti-Vibration Products on your next Diesel engine installation. Write us for full details.

•

The KORFUND CO., Inc.
4826 Thirty-Second Place
Long Island City, N. Y.

200,000
SUCCESSFUL INSTALLATIONS

LONDON LETTER No. 16

. . . . *Continued from page 41* . . . .

turn journey between the two places in a day, the total distance being over 240 miles.

As the boat will have to navigate in shallow channels with sandbanks, she is provided with a deep keel, and Thornycroft spiral propellers, such as were installed on C.M.B.'s during the Great War for boom jumping, are used.

The power plant consists of two type RL/6 Thornycroft oil engines of 4¾" bore and 6½" stroke developing 140 bhp. each at 1,800 rpm. These are four-stroke units employing antechamber combustion and fitted with aluminium alloy crankcases and renewable dry cylinder liners. They are of a type of which a number have already been used for yacht propulsion, and are well known for their reliability. Thornycrofts build a six-cylinder petrol engine of the same bore and stroke, its maximum output also being 140 hp. at 1,800 rpm. According to an article in the *Motor Boat* two of these engines were installed in a similar launch a few years ago, and some interesting comparisons are possible.

The petrol engines are each 1,240 lbs. lighter and cost £315 less, whilst the overall length is 1 ft. 6 ins. less. On the other hand, the Diesel engines burn fuel costing (in this country) 6d. a gallon, as against 1s. 6d.; and uses it at the rate of 7 gallons per hour, as against a consumption of 13 gph. Consequently, the running costs of both Diesel units are about 32s. an hour less.

The extra cost of the engines over petrol power plant should, therefore, be paid off in less than 400 hours' running, or, say, 40 round trips on the Shatt-el-Arab. So far as speed is concerned, there should not be more than half a knot difference.

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Diesel Fuel and
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Land and Marine
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around
the World

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Years have been spent in this important task. The lesson material is kept up to date by frequent issuance of Supplements devoted to latest developments. Our search for MORE Diesel engineering data will never cease.

Practical

The engines, laboratory facilities, testing equipment and shops of the Hemphill Diesel Schools include the world's widest selection of large and small engines for instruction purposes. The practical shop assignments given each student, and which must be completed to the satisfaction of the instructors, are as thorough as their Theory training.

"The Hemphill Diesel Schools are not home study or correspondence Schools, as we will not grant a Certificate until the student has had practical training . . . Without this training we feel the student is not qualified for Diesel responsibilities, no matter how thoroughly he may have mastered the theoretical part of his training."

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They are in no way associated with any other Schools of any kind.

Hemphill graduates are trained to serve the industry's requirements.

AMERICAN LAUNDRY

. . . . *Continued from page 37* . . . .

Credit — previous cost of heating 17,814 cu. ft. of water	53.56	
Actual cost of producing 13,980 kwh.	$43.63	
Actual cost, per kwh. for current produced	$43.63 / 13,980	= $00.00313

This shows that by the simple means of recovering ordinarily wasted heat the electric power cost has been reduced more than 50 per cent or from 7/10c per kwh. to less than 1/3c per kwh.

• • • •

American Laundry Company's saving in operating cost:

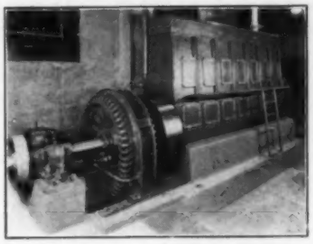
Electric power cost before Diesel plant was installed (average 8 weeks period)	$312.00	
Cost of fuel for heating water now provided by heat recovery system and electric heating coils	63.00	
Total		$375.00
Fuel and lubricating oil cost for producing electric current and heating water (8 weeks period) with Diesel plant		97.19
Savings in operating cost for 8 weeks period		$277.81
Estimated savings for period of one year		$1,666.86

• • • •

The American Laundry Company's Superior Diesel engine installation requires an average of only 15 to 20 minutes of the watchman's time each day to start in the morning, check oil and fuel and shut down at night. After starting no attendance is necessary, as the generator voltage is held constant by the automatic voltage regulator, the outlet-water temperature is maintained at 145° F. regardless of the load by the Sylphon valve, the engine speed is held at 1,200 rpm. by a built-in governor, and safety alarms on the engine lubricating and cooling water systems are provided to give ample warning of a failure before any damage could result.

The Diesel engine installation in the American Laundry in convincing evidence of the advantages of a properly engineered plant where the owner is provided with the facilities to reap the full savings of the Diesel engine.

8½ MILLS PER KW!



THEY USE A BUCKEYE DIESEL

● This 262½ HP, 175 KW, Buckeye Diesel Generator set pulls 150 to 175 KW, operating 90% of the time—not even shutting down on week ends.

Their Engineering Department writes: "Taking into consideration fuel and lubricating oil, labor, depreciation and fixed charges, we are generating power at an average cost of 8½ mills per KW."

This is just an example of the reliable and economical service produced with Buckeye Diesels.

Let us show you how much a Buckeye can save in your plant. Write on your Company letterhead.

SIZES 40 HP UP TO 600 HP

THE BUCKEYE MACHINE COMPANY
Engine Builders Since 1908
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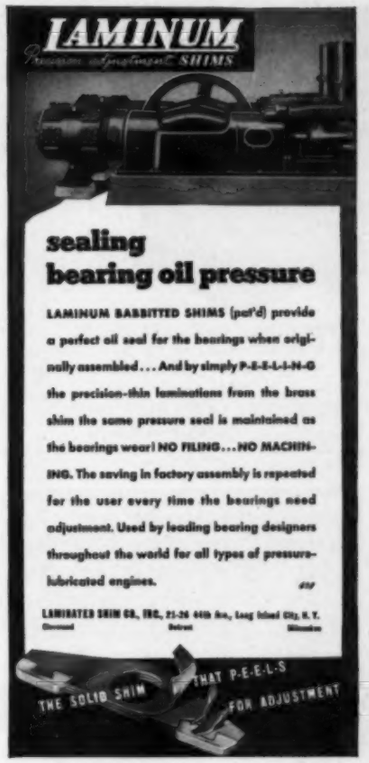
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Pressure adjustment SHIMS
sealing
bearing oil pressure
LAMINUM BABBITTED SHIMS (pat'd) provide a perfect oil seal for the bearings when originally assembled... And by simply P-E-E-L-I-N-G the precision-thin laminations from the brass shim the same pressure seal is maintained as the bearings wear! NO FILING... NO MACHINING. The saving in factory assembly is repeated for the user every time the bearings need adjustment. Used by leading bearing designers throughout the world for all types of pressure-lubricated engines.
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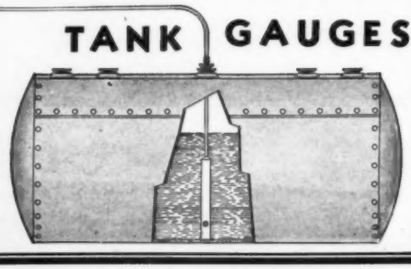

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THE VELLUMOID CO., WORCESTER, Mass., & DETROIT, Mich.

580 FIFTH AVENUE

. . . . *Continued from page 25* . . . .

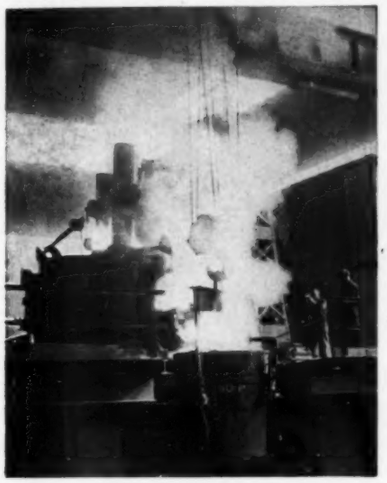
ity and one of 3,000 gallons for Diesel fuel. Fuel oil delivery is from tank truck at the sidewalk curb through filling pipes to the tanks. Number 6 fuel is purchased for the boilers, and number 4 for the Diesels. Boiler fuel flows by gravity from the tank to the pressure pumps between the boilers. Diesel fuel flows from the tank to the supply pumps on the engines, which deliver the fuel under slight pressure to a small chamber above the pump on the end of the engine.

The Nugent oil filters are placed in the corner of the engine room space. The twin filters for each engine are of large size and are the means used to keep the oil in prime condition.

The visitor to the plant is quickly impressed by the convenient arrangement of the equipment and the neat orderly working appearance. These attributes are but a reflection of the men responsible for them. Every day operation is in the capable hands of Mr. Charles Weder, Chief Engineer. Mr. C. E. White, Senior, is the Building Superintendent. The plant was designed and installed under the supervision of Mr. Harry J. Smith, Supervising Engineer for these properties. Mr. Smith has long been acquainted with Diesel engines. In the early part of his career he was with the De La Vergne and Busch companies, and was associated with Dr. Diesel himself during the visit of the latter to this country just before his death. Mr. Smith is also responsible for the combination Diesel and steam installation in the Ice Club at 50th Street and 8th Avenue described in the April, 1936, issue of DIESEL PROGRESS on pages 38 to 40. That plant is saving $16,000 a year net.

National Forge and Ordnance Company

Irvine, Warren County, Penna.



All National Forge and Ordnance Company products are manufactured from fine quality Basic Electric Steel.

Complete control of all processing from selection of the melting charge to the finished condition is National Forge and Ordnance Company's guarantee for maintenance of quality in crankshafts and various other types of forgings furnished to leading manufacturers in the Diesel industry.

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DIESEL PROGRESS

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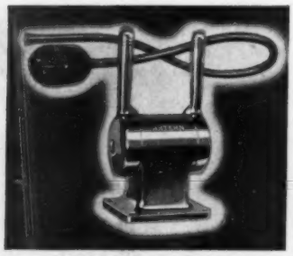
Every fine yacht, new or old, rates this Bendix modernizing equipment. Plenty of time to install on your ship before she goes overboard in Spring. The coupon brings full details.

Bendix-Holmes Automatic Steerer, showing compass, steerer head and wiring loom strap.



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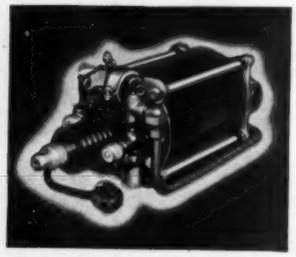

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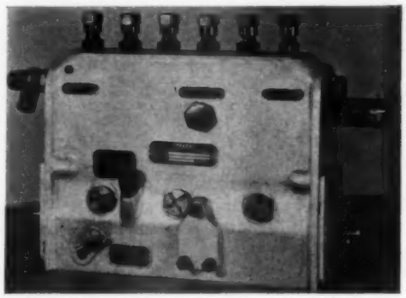
Size and kind of vessel owned.....

NEW DIESEL FUEL PUMP

THE Timken Roller Bearing Company has just announced two sizes of multiple unit, integral cam shaft pumps, one using a 4-9 mm. range of plunger sizes and the second a 5-11 mm. range. At present these pumps are being made for 1, 2 and 6 cylinder engines.

These new fuel pumps embody the latest technical and practical developments. Three years of laboratory development plus a full year of testing in the field on commercially operated Diesel trucks, buses and tractors, indicates that these Timken pumps not only are efficient but also have the stamina to continue to function with an absolute minimum of attention under the most adverse conditions.

They are of the cam operated helical plunger type, the metering being adjusted at the factory and sealed. An outstanding feature of these pumps is that they are driven by constant velocity cams. Thus the delivery speed of the fuel entering the combustion chamber of the engine is maintained constant at a speed adapted to the rate of combustion, thereby increasing the engine efficiency and fuel economy. The deceleration portion of the motion comes late in the stroke, thus permitting the use of a lighter spring and reducing the spring load between the tappet and the cam.

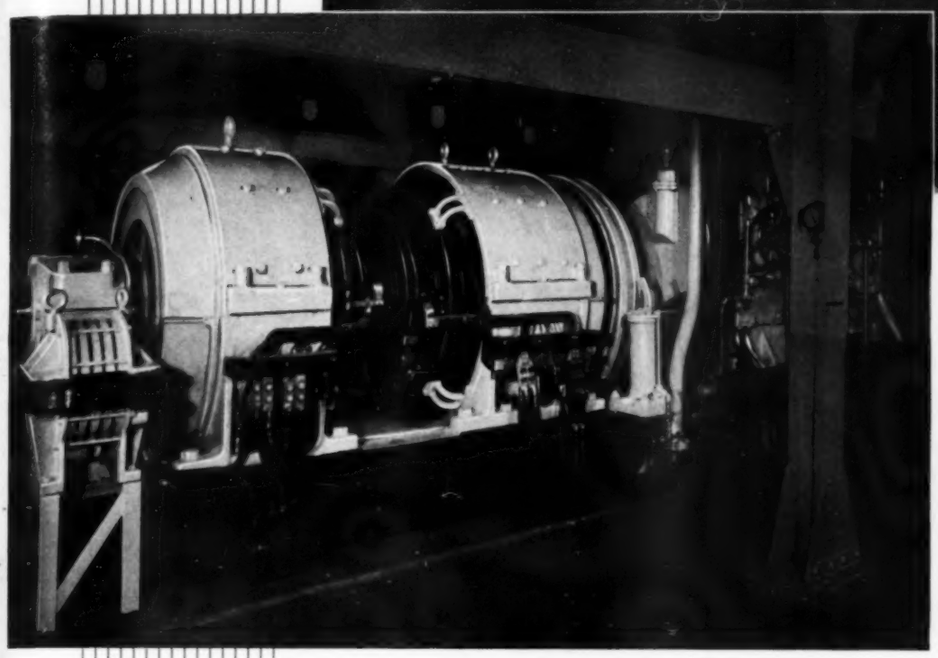


As these pumps must operate under pressures running as high as 10,000 pounds per square inch, and clearance between the plunger and the bore of the pump barrel is only .000030", it is essential that the housing be specially designed to provide the necessary stiffness, for even the slightest deflection would affect the accuracy of the unit. This has been done throughout the Timken pump and special alloy steels used to assure the strength needed.

For convenience in installation and in line with American practice, Timken fuel injection pumps are all made to fit standard bases and all connecting parts conform to standard dimensions. Likewise all parts are made on the American production plan, being interchangeable and easily replaced when necessary direct from conveniently located stocks.

The type A or small size pump using a 4-9 mm. range of plungers is adapted for use on Diesel engines up to approximately 150 hp. and operates at speeds up to approximately 4,000 rpm. The B size, using a 5-11 mm. range of plungers, is ordinarily used on engines from 110 to 250 hp., operating at speeds up to approximately 3,000 rpm. Field and laboratory data to date indicate that the engines on which these new Timken fuel injection pumps have been used have shown improved performance, giving more power at the same fuel economy and greater horsepower per pound of fuel. Trucks on which they have been used idle smoothly, and back easily, pull smoothly at all speeds when climbing grades and pick up rapidly when the throttle is advanced on level driving, the engines operating quietly and without obnoxious fumes at all times.

First public display of these pumps was made at the Annual S.A.E. meeting in Detroit, Jan. 11-15, and it is expected that sales and service arrangements will be announced in the near future.



The U.S. Engineers Dredge "Jewett" uses

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THE new U. S. Engineers Dredge JEWETT is the largest cutter hydraulic dredge ever built for use on inland rivers. Electrical requirements on the dredge are served by a main generating set consisting of an 840-hp. Busch-Sulzer Diesel engine driving two Elliott direct-current generators. One 375-kw. generator powers the cutter motor, controlled by the Ward-Leonard system. The other 250-kw. generator is a 3-wire unit which furnishes the auxiliary power required on the dredge.

Elliott generators and motors are at home on dredges and very familiar with this notably difficult service. They are well known in the dredging field and have established a reputation for rugged dependability.

These same characteristics, so desirable on *any* Diesel engine installation are inherent with Elliott generators of all types.

Besides dependability, Elliott engineers have always built into each generator such other characteristics as are required for the particular Diesel engine and the type of service involved.

Investigate Elliott generators for your job. They are built in all sizes and types required.

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BOTTOM — A 57-ton Diesel-electric switcher built for East Erie Connecting Railroad, powered by a 275-H. P. Cooper-Bessemer Type EN-6 Diesel.

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